Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LXVII. AUGUST, 1924 No. 2

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EDITORIALS

COMPLETE TRANSPORTATION SERVICE

The transportation service of the future is likely to be more diversified than it is today. It seems quite likely that railway companies, both steam and electric, will take up highway transportation to round out their service to the public. Even now there are precedents for a two-fold transportation service. More than one transportation company has utilized water as well as rail facilities in the past and, today, many electric rail lines are supplementing their rail service with bus lines. Some of the great trunk line steam railways are using trucks for short haul "peddler" service.

We believe this tendency promises much toward the consummation of complete transportation service. Highway transportation will be greatly improved when men long trained in the railway field turn their attention to truck and bus operation. There is, of course, a great deal to the art and science of transportation in addition to the actual operation of the carrier. That is, there ought to be more to it than just running trains up and down a track and trucks and buses up and down a road.

Everybody knows that rail men have made an exhaustive study of every possible phase of their type of service and of transportation in general. The same cannot be said of the truck and bus operators, as yet. Of course, we are still in the pioneering stage in gasoline transportation over the highways. It would not be reasonable to suppose that the highway transport men could master their subject as well in ten years as the rail men have mastered theirs in one hundred years. It is not our purpose to suggest comparisons of this, or any other sort, but to point out that the rail men understand many of the elements of profitable and satisfactory transportation service which they can quickly apply to highway transportation.

It has been noticed that some of the more successful truck and bus operators of today are men who have seen years of railway service, usually in minor capacities. What they learned from the railways has "helped them a heap" with the truck and the bus. This is just an indication of what we may expect when the really big men in the railway field turn their attention to transportation coordination and decide to supplement rail service with highway service. When the same brains are applied to highway transportation that have made our rail transportation facilities supremely great we shall have a rounded out transportation service that will dwarf anything the world has ever known.

BRICK PAVEMENT DESIGN

All who are interested in pavement design, whether for city streets or country roads, will appreciate the opportunity to read the article entitled, "Important Principles of Brick Pavement Design With Recommendations," which is published in this issue. The article is a noteworthy contribution to the literature of brick pavement engineering. The author proposes the use of brick of less depth than that now in general use for this purpose, but up to the usual standard of durability. He proposes the use of a Portland cement concrete foundation of less than the usual thickness but of increased strength and proposes to secure this increased strength by the use of steel reinforcement. The author feels that success with brick pavements in the past is largely due to the inherent virtues in the brick itself and has been secured in spite of faulty application of engineering principles. His article, therefore, seeks to apply correct engineering principles to this type of pavement construction. By reviewing the early methods of construction and their results, and by considering all available data relating to the proper design of modern brick pavements, he develops and recommends an economical design.

One of the most interesting features of the author's presentation is his advocacy of the use of brick of 2½ in. depth which is not now included among the standard paving bricks. He argues that this brick has proven its value and is more worthy of inclusion among the standards than some of the present

bricks of greater depth. He comments on the fact that the paving brick associations have somewhat discouraged the use of 2½ in. brick as its use increases the number of standard sizes. The editor hazards the opinion that this question of standards presents no great obstacle to true developments in the art of brick pavement design and construction. It was highly desirable to eliminate excess varieties but if engineering opinion calls for the inclusion among the approved standards of a 2½ in. brick the manufacturers are not likely to interpose objection as they have always been very responsive to well-considered engineering opinion. In fact, they have always been more than willing to govern their operations by the best engineering opinion of the day.

The article merits careful study and full discussion.

AN AID TO BETTER BUSINESS METHODS IN CONSTRUCTION

Many contractors are very poor business men. This need occasion but little surprise when the nature of the contractor's calling is considered. The present form of construction contract makes the contractor a gambler. If he were less a gambler and more a business man perhaps he wouldn't be a contractor at all. In the handling of equipment he has been very careless and this carelessness has dissipated much of his hard earned profit.

Much is being done to improve the contractor himself as well as the conditions under which he struggles. A very great deal of this praiseworthy work is being done by the Associated General Contractors of America, Inc., with headquarters at Washington, D. C. This splendid organization has done much during the short but fruitful years of its life to give to the construction industry a character it formerly lacked. We are glad to express our admiration and approval of this great organization which has done so much to associate the words skill, integrity and responsibility with the contractor.

One of the latest examples of the great service this organization is rendering the construction industry is the new A. G. C. pamphlet on Construction Equipment. This is a report on current practices pertaining to construction equipment including an equipment schedule, a rental agreement, equipment record and other forms. The pamphlet coordinates investigations extending over a period of several years. Its purpose is to present to construction companies data and forms which will enable them to formulate a sound, comprehensive equipment policy and to develop a satisfactory method of accounting equipment expense.

The pamphlet is quite new, yet we have heard it highly praised by contractors and construction engineers. Its use will put "more business in construction" and will make the contractor a better business man than he has been before.

HIGHWAY COMMISSION REGULATION OF HIGHWAY TRANSPORT

If we are to have commission regulation of common carrier motor vehicles, transporting either persons or property for hire over the public highways, in what commission shall the regulatory powers be vested? Shall it be a special commission or an existing commission? Answering the second question first, there seems rather general agreement that the occasion does not warrant the creation of a new commission. It is generally agreed that an existing commission be given this added responsibility. But which commission shall it be: the public service commission or the state highway commission? That is the question.

Leaders of thought in the motor transport field seem very generally to prefer regulation by the state public service, or public utility, or commerce, commission as it is variously called. They make a special point of wanting regulation by the *same* commission that regulates the rail lines. Why they do is more than we can surmise. If there is a sound reason back of this preference we never have heard it.

On the contrary, it would seem to be better not only for the public but for the motor transport operator to be under *any* other commission than the one that regulates the rail lines. It would save the latter commission much embarrassment not to have to regulate competing forms of transportation. Moreover, the average utility commissioner, after he has been properly educated by experts, looks upon the invested dollar as the most sacred thing in the world. He is almost sure to rule in favor of a rail line as against a highway transport op-

erator. This is not in line with the public interest. It is an effort to arrest progress by protecting those who would be injured by progress. This is always contrary to good public policy.

Highway carriers use the highways and should be regulated by the State Highway Commission. In most states the state highway system carries most of this form of traffic. These commissions already have employes patrolling the roads who could check up on speeds, weights, etc., as might be required by law. Any other matter such as the granting of franchises, fixing rates, approving schedules,, etc., could be handled by the members of the commission or by a division of the commission organized for that and similar purposes. This would relieve the "railroad commission" from all the embarrassments incident to the regulation of highway transport. Many states have already vested this control in the "railroad commission." We feel sure it would be better to transfer it to state highway commissions. The latter commissions do not want the job but would handle it properly if given the responsibility.

ONE HUNDRED YEARS OF ENGINEERING EDUCATION

It doubtless comes as a surprise to many of us, who think of engineering education as a comparatively recent development, to learn that it is now one hundred years old. Rensselaer Polytechnic Institute, the oldest school of science and engineering in any English-speaking country, will celebrate the one hundredth anniversary of its foundation in October of this year. The centennial exercises will commemorate the development of science and engineering in the United States and will be international in character.

The exercises will be held at Troy, New York, on October 3 and 4. There will be in attendance official delegates from educational institutions, scientific organizations, and engineering societies throughout the world, as well as from each alumni association and from each class since 1857. There will be 21 formal addresses by distinguished engineers and engineering educators, of this and of foreign countries, and by men high in public life.

Congratulations are extended to Rensselaer by the engineering and scientific world and by the general public which has benefited so greatly from the progress in daily life that has sprung from the applications of engineering science.

IMPORTANT PRINCIPLES OF BRICK PAVEMENT DESIGN WITH RECOMMENDATIONS

By Willis D. P. Warren, of Holbrook, Warren & Van Praag, Civil Engineers, Millikin Building, Decatur, Illinois

General

The object of this article is to present a statement of the fundamental engineering principles which govern the economical design of a brick pavement, to point out the importance of their careful consideration, and to submit a design which will embody the application of such principles. This article treats of original conditions and factors which governed early design, emphasizes the changed conditions and discusses the design of a brick pavement considered as an engineering structure.

On the basis of the data herein submitted, a design is recommended wherein it is proposed to use brick of less depth, but of equal durability, and a concrete foundation of less thickness but of greater strength. It is proposed to secure this greater strength in the foundation by the use of steel reinforcement.

Virtues Inherent in Brick

Although many of the brick pavements of the past have been constructed in total disregard of proper engineering principles they have demonstrated certain virtues in spite of this fact, and have uniformly maintained a high standard of quality regardless of such neglect. In this connection it is desirable to note that the virtues inherent in our older brick pavements have been due to the wearing qualities and toughness of the brick surface, rather than to any special virtues in the other component parts of the pavement, such as the foundation, filler, or cushion. This important truth is borne out in numerous instances, for despite the character of foundation, the thickness of cushion, the type of filler, or the lack of maintenance, brick pavements, as a rule, have demonstrated unusual merits throughout the period of their general use.

Assuming this to be true, it should be possible so to combine the correct principles of design as they relate to the

foundation, cushion, wearing surface, and filler, that when applied to the design of the brick pavement as a whole, the resulting structure will possess the necessary virtue of durability, and the added virtue of low first cost. In spite of the recent improvements and developments in methods of design and construction, it will be seen that there is yet opportunity for a more efficient and economical design, and particularly for a more "positive" design.

By reviewing early methods of construction, by closely studying the results of such construction, and by considering all available data relating to the proper design of modern brick pavements, it should be possible to develop such an economical design.

Early Methods of Construction

Brick pavements have been in more or less general use in the United States for the past 40 years, although a few such pavements were constructed at earlier dates. Early foundations generally consisted of gravel or broken stone, or of a course of brick laid flat upon a previously compacted layer of sand. The drainage of early pavements was naturally poor, as few storm drains had been constructed resulting therefore in frequent settlement of the foundation.

Due to the more or less irregular top surface of the foundation course of brick it was considered necessary to spread a sand cushion over it, the cushion varying in depth from 1½ to 2½ ins. Upon this cushion, or "leveler," the brick wearing surface was laid. As many of the original brick used for paving purposes were building brick, or brick of similar dimensions, they were laid in such a manner that the wearing surface was 4-ins. in thickness or depth. Many of these old style pavements are still in use, and where they have not been too frequently disturbed by sewer and other trenches, they are in remarkably good condition today.

It is quite generally conceded that the early methods of construction were far from efficient; however, it is desired to emphasize that in spite of the foundation conditions, the poor drainage, and the ever increasing volume of traffic, the brick wearing surface on such pavements has demonstrated a strength and durability of the highest character. The point to be made is that the individual brick, poorly and irregularly supported has rendered a service which suggests the wider use of a brick wearing surface of less thickness. A brick wearing surface of less thickness should be supported by a proper and substantial foundation, affording each individual brick a firm and uniform support throughout its bedded surface.

Present Methods of Construction

It may be briefly stated that present methods of construction show many changes and improvements over early methods. The use of a concrete foundation of varying degrees of thickness and strength is common practice, and the use of steel reinforcement in such a concrete foundation, while not common practice, is now considered by many engineers to be good practice.

The old sand cushion, of substantial thickness, has been replaced by a sand cushion of less thickness, but spread to a uniform depth.

The brick wearing surface now varies in thickness from 2½-ins. to 4-ins. with occasional variations above or below these figures. The excellent qualities of the individual brick as demonstrated in the early pavements has led to a more general use of a brick wearing surface of less depth. The use of vertical fibre brick, without lugs, has also tended to the development of additional strength in the brick wearing surface. The use of sand, cement, and bituminous fillers has been common practice as various times; however, experience has shown the decided advantages of bituminous fillers.

Brick pavements constructed under present methods of design indicate quite clearly the possibilities of a more positive and less expensive type of brick pavement.

Fundamental Engineering Principles

Fundamental engineering principles governing the design of a brick pavement should be based on sound engineering practice and experience, rather than on past or present practice in design.

Independent of present practice, insofar as arbitrary design is concerned, but with due regard for present and also for past practice, insofar as fundamental engineering principles are involved, it will be of real interest and importance to analyze the principles which affect the economical design of a brick pavement. These may be briefly outlined as follows:

1. A brick pavement is an engineering structure consisting essentially of (a) a foundation or support to the brick wearing plate, (b) a cushion spread on the foundation to serve as a "leveler", and (c) a brick wearing plate or surface,

composed of individual brick, the joints being filled with materal for the purpose of waterproofing the subgrade.

2. The depth of brick pavement foundation, and the nature and character thereof, are dependent upon the subgrade conditions and the weight and character of the loads to be supported and distributed.

3. The depth of the cushion shall be sufficient to permit the leveling of any inequalities in the foundation, and to eliminate any unevenness in the brick wearing surface; and the materials composing the cushion shall be of a nature to accomplish these results easily, and, in addition, may also be of a character such as to lessen the shock of traffic.

4. The brick wearing surface shall be of a tough and durable nature, capable of resisting the abrasive wear of traffic. The individual brick shall be of a quality and strength sufficient to accomplish this purpose, and to transmit the weight of traffic to the foundation. The size of the brick which comprise the wearing surface shall be such as to permit them to be readily handled, and to provide a minimum of joints. The depth of the brick shall be sufficient to give them proper strength to resist the abrasive wear of traffic, and to transmit the weight of traffic to the foundation.

5. The most economical brick pavement is one in which the various materials composing it are assembled and combined in such a manner that each shall most effectively serve the purpose for which it is intended, to the end that the resulting structure as a whole shall not only possess the requisite strength and durability, but moreover, that it shall be low in first cost and low in annual maintenance cost.

Considering all the surrounding conditions and requirements it will be interesting further to investigate the various component parts of the proposed brick pavement structure.

Foundation

The purpose of the foundation is to support and maintain the individual brick of the wearing surface in proper position, and to receive and distribute the weight of traffic, as transmitted through the brick, to the subgrade. The foundation must necessarily therefore, be of sufficient strength properly to span and bridge over the weak or soft spots in the subgrade, and to distribute the weight of traffic in such a manner that the individual brick comprising the wearing surface will not be forced down, or disturbed in their true position in the pavement.

In this connection Maurice B. Greenough, in a paper read before the Illinois Society of Engineers at its 1921 meeting made the following statement: "The artificial base primarily serves as a medium for the transmitting of loads and forces from the wearing surface to the natural foundation where they are fitly disposed of." Also Bulletin No. 246 of the U. S. Department of Agriculture, offers the following interesting statement as to the purposes of the foundation of a brick pavement:

"A firm, unyielding foundation is one of the most essential features of a brick pavement. This fact can be more readily appreciated when it is considered that the surface of a brick pavement is made up of small individual blocks, any one of which might be easily forced down, causing unevenness in the surface, if the foundation were poor; and since the ability of the pavement to resist wear depends very largely on the smoothness of the surface, every reasonable precaution should be taken to prevent any unevenness from developing."

The purpose of the foundation is also discussed by Mr. Clark R. Mandigo in a booklet entitled "Brick Pavements," published in 1917 by the W. P. B. M. A. Following is Mr. Mandigo's statement:

"The purposes of a foundation may be itemized as follows: (1) to distribute the wheel loads over a sufficient area of the subgrade so that the bearing power of the soil will not be exceeded; (2) to bridge over soft spots in the subgrade; (3) to provide a rigid, uniform bed for the laying of the wearing surface, and (4) to protect the wearing surface both by the absorption of shocks due to the impact of swiftly moving loads and by maintaining the surface to uniform grade."

From the above statements, and from a knowledge of foundation requirements, it will be noted that there is general agreement as to the requirements and purposes of the foundation. The problem then is to determine how best to design it in order that it will most economically accomplish the purposes for which it is intended.

Going back to the fundamental principles governing the design of engineering structures, it is recalled that a foundation is the basis, or lowest part of a structure, in other words the support, or

footing, designed for the purpose of receiving, transmitting and spreading weights and loads to the natural soil, or to some artificial support. Where the natural soil has a high bearing value, or the loads are not excessive, the foundation may be of minimum thickness. However, when it has been determined that the bearing value of the natural soil or subgrade is uncertain and irregular, that it is subject to substantial variations in elevation due to frost, moisture content, settlement or other causes, it is quite imperative that the foundation be so designed and constructed that it will have (a) sufficient strength to resist crushing, (b) to receive and distribute the weight and shock of traffic, (c) to bridge over soft places in the subgrade, (d) and to support the wearing surface in its true position.

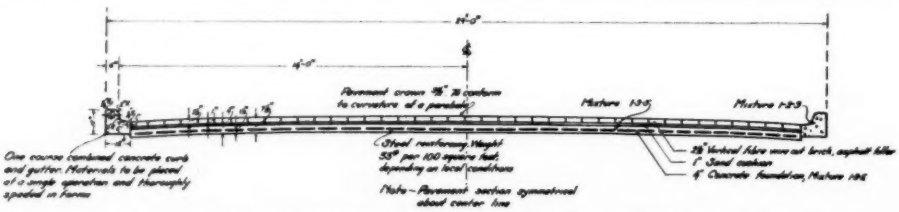
Experience has shown a concrete foundation to possess many advantages over others, and considering the nature of the duty to be performed by it, experience has demonstrated that this duty can be most positively and economically accomplished when steel reinforcement is embedded therein. What is the purpose of steel reinforcement in concrete where used in an engineering structure? What is reinforced concrete?

Reinforced concrete is concrete in which iron, steel or other metal is embedded in such a manner as greatly to increase its strength, especially with respect to tensile stresses. A combination of steel and concrete constitutes a form of construction possessing in a large degree the advantages of both materials without their disadvantages. Concrete is characterized by low tensile strength, and for this reason the use of reinforcement is essential in a concrete foundation, subjected as it is at times, to unusual tensile stresses.

The use of steel reinforcement will decrease the cost of the foundation, for it will give increased strength with a substantially less thickness of concrete; in fact it will economically accomplish the purposes for which it is intended, just as it economically accomplishes the purposes for which it is intended where used in other engineering structures. Considering present prices and present methods of construction, it appears that where increased strength is required in a foundation it may be best obtained by a reasonable and proper thickness of concrete with additional strength being developed by the use of heavier steel reinforcement, the correct amount depending upon the character of the particular subgrade, and the nature of the traffic to be provided for. The use of a reinforced concrete foundation for a brick pavement is not a new departure, although its general use is not considered common practice. For foundation purposes, reinforcement should be placed near the bottom of the concrete slab.

In the above connection the Bates Experimental Road Tests are of considerable interest for they demonstrate the necessity and value of reinforcement in a most convincing manner. As pointed out by Mr. Older in Bulletin No. 18, Department of Public Works of Illinois, the tests show distinctly a periodic separation of the pavement slab and the subgrade, and they show also the value of reinforcement in the transmitting of loads from one pavement slab or section to an adjoining one. This effect is greatly aided by the use of steel dowels and reinforcement, and where the abutting sections of concrete are in actual contact, there is secured an interlocking effect which also tends to assist in distributing the weight of traffic without allowing any change in the vertical position of the abutting pavement surfaces. Naturally, steel bars, or steel mesh fabric reinforcement will make this interlocking effect more positive in the foundation, and will effectively distribute the weight of traffic over weak spots in the subgrade.

The Arlington Investigations have also given much information of value regarding pavement design. They show how the load per unit area increases, as the area of the bearing block decreases, and confirm our knowledge that a pavement slab


Pavement crown 15" in conform to curvature of a parabola
Mixture 1:3:5
Mixture 1:2:3
Steel reinforcing. Weight 30# per 100 square feet depending on local conditions
Note—Pavement section symmetrical about center line

TYPICAL CROSS SECTION OF BRICK PAVEMENT FOR CITY STREET.

carrying a heavy load, deflects and compresses the subgrade over an area of several square feet. The Pittsburg Tests bear out this principle quite clearly in that they show less destruction of the slab, where longitudinal joints are used than where they are not used. In other words, the longitudinal joint permits this deflection under a heavy load, without rupture of the pavement slab at irregular intervals.

The point to be emphasized is that a brick pavement foundation should possess a certain degree of "elasticity", and that this can be economically secured by the use of steel reinforcement. In concrete highway pavements, we secure the most economical design by the use of a longitudinal construction joint, with certain reinforcement provided in addition.

Applying this principle to the design of a brick pavement foundation, it is found that the use of reinforcement is the most economical means of securing the desired elasticity. This fact will be more fully appreciated when it is recalled that the use of reinforcement in the foundation of a brick pavement is not required necessarily to prevent cracking, as is one of the chief purposes in concrete pavement construction, but that it can serve its function quite successfully and yet allow the foundation slab to be cracked and shattered in a way which would be ruinous to a concrete pavement. We must therefore distinguish, in applying the results of various tests, as to the purpose for which reinforcement is to be used, and bear in mind that the amount of reinforcement required in the foundation of a brick pavement may be substantially less than that required in a concrete pavement, considering all the purposes for which each is designed, and all the circumstances and conditions under which they are to be used. The essential fact,fi however, is that elasticity in both cases is not only desirable, but necessary, and that it can be best assured by the use of steel reinforcement, particularly in foundation design.

In this connection it may be well to restate a well known principle of structural design as follows:

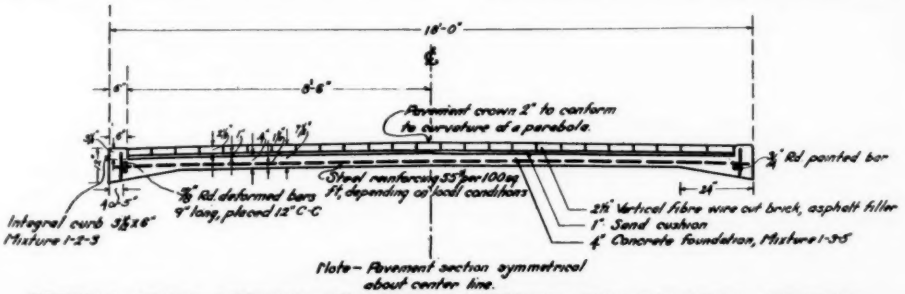
"The flexural strength of concrete is low as compared with its compressive strength; the use of steel bars to supply this deficiency is the basic principle of reinforced concrete construction." This law is absolutely universal, and applies with added force in the design of a brick pavement foundation. In such a foundation, tensile cracks are not objectionable, as will be readily appreciated, although in most other engineering structures they are quite the contrary. This distinction should be clearly understood, and advantage taken of it in brick pavement design.

In line with this discussion, it may be of interest to know that the writer, in an article entitled "Brick Pavement Design," published in Engineering and Contracting July 7, 1915, strongly urged the use of steel reinforcement in brick pavement foundations.

An editorial in the Canadian Engineer, quoted in Engineering and Contracting of December, 1923, discusses "Reinforced Concrete Under Shock," in part as follows:

"Accounts of the behavior of the reinforced concrete buildings in the recent Japanese earthquake disclose some astounding facts with respect to the resistance to shock of the material of these structures. . . . It might perhaps be expected that the concrete surrounding the steel would be shattered in very much the same manner as a member of plain material, but so intimate is the effect of *steel* on the *concrete* that the two appear to *behave elastically* in a manner much more like steel than like concrete."

Numerous tests have been made indicating the advantage of a reinforced concrete foundation over a plain concrete


18'-0"
6'
6'-6"
Pavement crown 2" to conform to curvature of a parabola.
Steel reinforcing 55 lbs per 100 sq ft, depending on local conditions
¾" Rd pointed bar
¾" Rd deformed bars 9" long, placed 12" C-C
Integral curb 3½x16" Mixture 1-2-3
2½" Vertical fibre wire cut brick, asphalt filler
1" Sand cushion
4" Concrete foundation, Mixture 1-3-5
Note - Pavement section symmetrical about center line.

TYPICAL CROSS SECTION OF BRICK PAVEMENT FOR COUNTRY HIGHWAY.

foundation, and considering the more positive results to be secured, and the decreased cost, it is evident that good engineering practice requires its general use in the design and construction of a brick pavement.

Cushion

Assuming the use of steel reinforcement in the concrete foundation, there can be little objection to the ordinary sand cushion, for the tendency of the sand to sift away through cracks in the foundation should be entirely eliminated. Its cheapness and general effectiveness have been demonstrated through years of satisfactory service, particularly where spread to a proper depth on a satisfactory foundation. A sand-cement bed fails in several ways to meet the requirements of a satisfactory cushion under present traffic conditions, and its general use has been almost completely discontinued.

Brick Wearing Surface

It is desired again to emphasize the fact that a brick wearing surface should be tough, durable, and capable of resisting the abrasive wear of traffic. The individual brick should be of a quality and strength sufficient to accomplish this purpose and to transmit the weight of traffic to the foundation. The size of the brick comprising the wearing surface should be such as to permit ease in handling, and to provide a minimum of joints. The depth should be sufficient to give the brick proper strength to resist the abrasive wear of traffic and to transmit the weight of traffic to the foundation.

It is very interesting in this connection to observe the character of brick in many of our older pavements, where such brick have withstood the most severe abuse due to lack of proper foundation. In view of the strength thus demonstrated, it is quite evident that a less thickness of brick wearing surface is required with present foundation provisions, than was necessary under past conditions.

Many engineers have realized this fact and have pointed out the economy of a brick wearing surface of less thickness.

Halbert P. Gillette, in his Hand Book of Cost Data, P-359, discusses this important subject as follows: "For street pavements the bricks or blocks are laid on edge (making a brick pavement 4-ins. thick), but for sidewalks they are generally laid flatwise. I believe that in residence streets the bricks should usually be laid flatwise for true economy's sake."

Mr. James T. Tucker, Director, School of Civil Engineering, University of Oklahoma, discussed the use of brick laid flatwise in a most interesting article published in Engineering and Contracting under date of November 19, 1913. Mr. Tucker pointed out the economy of a 3-in. depth of brick wearing surface over a 4-in. and also the increased strength of a vertical fibre brick, as well as the value of reinforcement in the concrete foundation.

Also, in this same issue of Engineering and Contracting, there is an editorial which is of peculiar interest and importance in this connection. Following is a portion of the editorial: "An 8¼x3x3½-in. paving brick covers 4⅛ sq. ins. more surface if laid flatwise, that is with its 3-in. side vertical, than it does if laid in the more usual manner with the 3½-in. side vertical. Is there any sound reason why brick pavement of brick laid flatwise will not in most cases have all the strength and endurance needful? We do not think there is and we long ago recommended to engineers editorially the practice of laying paving brick with the broad side horizontal. . . ."

With a substantial foundation, and a cushion of proper depth, there is ample evidence to show that a brick wearing surface of not to exceed 2½-ins., depth possesses the essential qualities of toughness and strength required in a wearing plate or surface. This statement is borne out by numerous examples, wherein the brick wearing surface has resisted the destructive forces of traffic, regardless of the nature of the supporting foundation.

It is now proposed to use a less thickness of brick, supporting it in such a manner that it will be subject only to the crushing and wearing action of traffic, rather than to the shock and pounding of traffic, plus the crushing and wearing action, as was the case in the older pavements. The use of 2½-in. brick is not altogether new practice, as thousands of square yards have been constructed under the specifications of the Western Paving Brick Manufacturers' Association, and furthermore, pavements so constructed have proven quite satisfactory, particularly where the foundation requirements were not too greatly neglected. The mere fact that a 2½-in. brick is not considered one of the so-called "standard sizes" is of no moment or concern, or importance, provided such a brick will serve all the ordinary uses and purposes of a 3-in. or 4-in. brick.

In this connection it is interesting to note that both the Western Paving Brick Manufacturers' Association, and the National Paving Brick Manufacturers' Association, report that 2½-in. brick have been satisfactorily used. These Associations have, however, somewhat discouraged the use of a 2½-in. brick on the theory that its use increases the number of standard sizes. This is rather a narrow view, considering its satisfactory use, and certainly is no sound argument against its wider use, since experience has now demonstrated its possibilities. Again, considering the service rendered by a 3-in. brick, it is quite possible that 3½-in. and 4-in. sizes should be eliminated as so-called "standards," rather than the 2½-in. size. The experience of cities which have used this type of brick will be of peculiar interest, and reference is therefore made to results in several typical cities.

Amarillo, Texas with a population of 21,000 has a total of approximately 110,000 sq. yds. of 2½ in. brick on a 4-in. foundation, and a report from Mr. H. B. Jones, Engineer, states that 16th Street with 9,000 sq. yds. of this type six years old, has "no flaw." The results at Amarillo are quite surprising considering the weak character of the foundation, and speak well for the 2½-in. brick.

Larned, Kansas, reports approximately 50,000 sq. yds. of 2½-in. brick on a 4-in. foundation. Mr. George M. March, City Engineer, reports that State Street with 13,000 sq. yds. is a representative street and that the condition of the pavement on the above named street is "excellent."

Weatherford, Blackwell, Okunak, and Wynerwood, Oklahoma, are other cities where 2½-in. brick have given satisfactory service.

When once incorporated in the finished pavement, and bedded to a true surface, a 2½-in. brick will possess substantially every virtue of a 3-in. or 4-in. brick, and in addition will be far less expensive in first cost, and moreover, less expensive to replace when maintenance shall finally be required. Quotation from the manufacturers tend to show that a 2½-in. brick can be placed in the pavement for about 83 per cent of the cost of a 3-in. brick.

Considering the opinions of the well known authorities, as above cited, considering also the qualities of toughness and durability, as demonstrated in the older brick pavements built under poor design and supervision, and finally, considering the character of a 2½-in. brick as indicated by satisfactory service in actual use under average conditions, it is evident that a 2½-in. brick should be adopted as a standard size, to be used where a 3-in. brick is now ordinarily used. With our present *mechanical methods* of securing a bedding cushion of uniform and proper depth, and of absolutely true surface, there is no danger of breaking the brick in rolling, as was sometimes done in the past where such *accurate mechanical methods* were not the rule.

Considering the fundamental principles of brick pavement design, as hereinbefore discussed, it is apparent that the 2½ in. brick possesses merit which entitles it to use as a "standard size" paving brick.

Proposed Design

Many years of brick pavement construction have demonstrated certain fundamental principles, and considering these principles in the light of our present knowledge of the design of engineering structures, as well as in the light of the present requirements as to strength and durability of brick pavements, it is quite evident that opportunity is now offered for a design based on broad engineering principles, rather than on precedent or common practice.

Considering then the foundation, and referring to the above discussion regarding the same, it is desired to point out further that in the Bates Tests, the brick with asphalt filler stood up remarkably well on foundations of 3½-ins. and 4-ins. of concrete, the foundations failing first at the edges. Had such foundations been properly strengthened by reinforcement at the edges, and by bars or mesh in the slab proper, it is safe to assume that there would have been no failures what ever.

Tests have demonstrated that a reinforced concrete slab will develop approximately twice the ultimate strength of a plain concrete slab of equal thickness, and considering the uses and purposes of a brick pavement foundation, it is readily apparent that steel reinforcement should properly be one of the materials to be specified in its design. An increasing number of cities are now specifying such reinforcement. The writer has specified steel reinforcement in a rather large yardage of brick pavement foundation to be constructed this year.

In the design of a highway pavement, experience requires that provision be made for a foundation of very substantial character, and such a foundation can be

secured by constructing a 4-in., 1-3-5 concrete slab, reinforced with steel bars, or mesh fabric having a weight of 55 lbs. per 100 sq. ft., more or less, depending on the character of traffic, and the subgrade conditions. Such a foundation may be thickened at the edges, and further strengthened by the use of ¾-in. longitudinal bars placed about 6 ins. from each edge. By building the curbing integral with the foundation, with ⅝-in. bars about 9 ins. long, placed 12 ins. center to center, joining the foundation slab and curb, (making the curbing integral with the foundation), a permanent and substantial structure will be formed for the support of the wearing surface, and such loads as may be transmitted through it to the subgrade.

The accompanying detail drawing indicates a type of pavement suitable for highway purposes, combining several materials in a manner to develop the desirable qualities of each in just the proportion considered essential for the most economical design of the structure as a whole. Good practice appears to dictate that 4 ins. is about the minimum thickness of foundation, and that additional strength shall be developed by the use of heavier reinforcement, as local conditions may require.

The construction of a pavement of this design presents no special difficulties, as the reinforcement in the foundation slab may be placed on the subgrade and supported at its correct height before pouring concrete. Ease in constructing the integral curb with a 1-2-3 mix is accomplished by using the ⅝-in vertical bars which eliminate any danger of poor bond between the foundation proper and the curbing. The sand cushion and 2½-in. brick wearing surface can be readily laid to an absolutely true surface.

In the design of a city pavement conditions are somewhat different. However, it is thought that on account of present traffic conditions and the liability of street excavations, a 4-in. thickness of foundation is about the minimum which should be properly used, even where reinforcement is to be included. Past practice in the use of thin plain concrete foundations has resulted in some early brick pavement foundation failures where subgrade conditions were treacherous.

The foundation should be reinforced about the same as on highway pavements the weight of reinforcement varying with the subgrade conditions and the character of traffic. The accompanying drawing illustrates a typical cross-section for a city pavement.

Good practice in the design of either highway or city pavements requires provision for a certain factor of safety, and the use of a 4-in. concrete foundation with steel reinforcement satisfies this requirement insofar as the foundation is involved.

With present prices, the cost of 5 lbs., of reinforcement per sq. yd. (55 lbs. per 100 sq. ft.) of pavement is about equal to the cost of a square yd. of concrete 1-in. in thickness. Such reinforcement in a 4-in. concrete foundation slab, (1-3-5 mix), will give it an ultimate strength equal to that secured by a plain concrete foundation slab having a total thickness of six or seven inches. In this connection it is desired again to point out the fact that cracks in a foundation slab are not considered seriously objectionable where the adjoining slabs of concrete are held in their proper positions by reinforcement, or such cracks are not exposed to wear, and furthermore, the full strength of any reinforced concrete structure is not developed until after cracks appear in the concrete.

The purpose of the foundation is principally to distribute the weight of traffic, and to bridge over soft places in the subgrade, and yet with a plain concrete foundation, failure of the entire pavement structure may result when the tensile and flexural stresses are exceeded. On the other hand, with proper steel reinforcement, the tensile and flexural stresses in the concrete foundation will not determine the ultimate strength ot the structure as a whole. In other words, by the use of such reinforcement, a factor of safety is secured not only in the foundation, but in the entire pavement structure.

It is thus seen that with a less thickness of pavement, requiring less earth excavation, with a more reliable and positive method of supporting and distributing the weight of traffic through the reinforced concrete foundation, and that with a less expensive wearing plate, both in first cost and in maintenance cost, a design is proposed which combines all the essential elements required in a first class pavement structure, as hereinabove set forth.

Repairing and Resurfacing

One of the big engineering problems in our cities today is that of the repair and resurfacing of old pavements. The

2½-in. brick is ideal in this connection in that its first cost is low, its wearing qualities excellent, and furthermore, when repair and resurfacing become necessary, it is easily adaptable to the repair of small or large areas.

On highway construction, it is safe to predict that repair and maintenance will be the big problem of tomorrow, and what simpler and more economical method could be proposed than that offered by the use of a 2½-in. brick? The ease, low cost, and rapidity with which small areas could be repaired, and the economy of resurfacing with 2½-in. brick on a substantial existing foundation, are points of vital concern to highway engineers.

Comparative Costs

Considering the present typical design for a city pavement, one which offers substantially the same strength and wearing qualities as would be secured in the proposed design, it is evident that an appreciable saving in first cost and in annual cost is possible where the proposed design is used. In this connection it is desired to note that while many brick pavements have been constructed on thin plain concrete foundations, the present traffic requirements call for more substantial construction. (Where improvements are contemplated on very light traffic streets there is no real reason why the cost of the pavement may not be kept at a minimum by the use of a reinforced concrete foundation, specifying a light weight reinforcement).

The proposed typical design as indicated on the accompanying sketch contemplates a 4-in. 1-3-5 concrete foundation reinforced with approximately 5 lbs. of steel mesh or bar mat reinforcing per sq. yd; a 1-in. sand cushion, and a 2½-in. brick wearing surface, with asphalt filler. The present typical design, of equal strength and durability, would require a 6 or 7-in. plain concrete foundation, 1-in. sand cushion, and 3-in. brick wearing surface, with asphalt filler.

It is thus seen upon analysis that the proposed design will provide a pavement equal in strength and durability to that of the present type, and do so at a first cost of approximately 80 to 85 per cent thereof.

On highway construction, the saving will also be a very substantial item, probably somewhat greater than on city work. The reduced thickness of pavement slab will effect a saving in the hauling costs, as well as in the labor and material costs. In this connection it should also be observed that the earth excavation will be from 2 to 2½-ins. less on account of the thinner pavement slab, thus affording another opportunity for economy in construction.

Again considering maintenance, repair, and renewal, it is observed that the average annual cost over a period of years will be substantially less with the proposed design than with the present design.

More General Use of Brick Pavements

Each type of pavement has its advantages, and each may be properly used under certain conditions and in certain localities. The fact still remains, however, that a brick wearing surface built in combination with and on a proper foundation, affords one of the very best pavements which can be constructed for average conditions, and if economically designed, one of the very cheapest.

In this connection is may be safely stated that no type of wearing surface, when supported by a weak foundation, will resist the destructive forces of traffic and of the elements, in a more satisfactory manner than a brick wearing surface will.

Experience has demonstrated certain qualities of durability and toughness in a brick wearing surface, and yet the fact remains that our present methods of design and construction are such that we limit to a considerable degree the wide use of this valuable paving material.

Considering the record of our old brick pavements, and the economies possible with a somewhat more rational design, it is predicted that a far greater use will be made of brick as a paving material on future improvements. This should apply both to municipal and highway projects.

Conclusion

In conclusion it is desired further to emphasize certain points discussed herein, and to summarize them as follows:

1. A brick pavement is an engineering structure, built to serve certain uses and purposes, and its design is subject to, and should be based on well-known engineering principles.

2. The demonstrated durability and toughness of brick as a paving material justifies the wider use of a paving brick having a thickness of not to exceed 2½ ins.

3. The foundation of a brick pavement is designed primarily to receive and distribute the weight of traffic to the subgrade, to withstand shock and to bridge

over soft or low places in the subgrade, and in order to accomplish these purposes most economically should be constructed of reinforced concrete.

4. The most economical brick pavement is one in which the various materials composing it are assembled and combined in such a manner that each shall most effectively serve the purpose for which it is intended, to the end that the resulting structure as a whole shall not only possess the requisite strength and durability, but moreover, that it shall be low in first cost and low in annual maintenance cost.

5. The application of fundamental engineering principles in brick pavement design will secure a more serviceable pavement at a substantially less cost.

In final conclusion, the writer desires to state that in his judgment, both tests and experience strongly support the typical designs herein proposed. In suggesting such designs, however, it is his desire rather to stimulate a much needed and helpful discussion, than to attempt arbitrarily to present a final solution of the important problem of brick pavement design.

THE 1925 ROAD SHOW

The 1925 Road Show and Convention of the American Road Builders' Association will be held at Chicago, January 5 to 9 inclusive. This is about 10 days earlier than usual. C. M. Upham, business director of the Association, announces that much better arrangements have been made for both the show and convention than in any previous years. The preliminary plans also are already as far along as has been usual at a much later date. Every indication, therefore, is that these two big annual events in the road-building industry will in every way eclipse all past records.

The program committee which will have charge of the convention will be headed by Prof. T. R. Agg. He expects to have the organization of his committee completed soon. Professor Agg has had such a variety of experience in the highway field that he will be able to produce a well-balanced program of general interest. The convention sessions will be held at the Congress Hotel.

Nearly 17,000 sq. ft. of additional floor space suitable for heavy exhibits will be provided at the Coliseum. This additional space is being obtained by the extension of the Coliseum to the north. The present main building and the adjoining building which have been used in the past, also will be available. There will thus be room for more and better exhibits than in the past.

Additional doors for bringing in the heavy exhibits also have been arranged. Plenty of time to get exhibits into the buildings further will be allowed by the schedules made possible by the dates of the show. These improved arrangements coupled with the wonderful success of the last two road shows insure the largest and best industrial machinery exposition ever seen in this country.

Aplication blanks for space in the Road Show will be mailed shortly by Mr. Upham to all concerns whose names are available. Additional blanks may be obtained by addressing him at 37 West 39th Street, New York City.

Committees are being formed to handle the annual banquet, hotel arrangements, registration and various other features. The plans for these features, as well as for the show and convention, will all be arranged long in advance of what has been customary in previous years. With greater interest in highway building than ever before, the attendance from all parts of the country thus is certain to break the remarkable records of the last show and convention.

SOME LEGAL ASPECTS OF COMPETITION AMONG ENGINEERS

To the Editor:

There are Federal statutes against restraint of trade in interstate commerce and nearly all of the states have similar laws applying to intra-state commerce. These laws make no distinction between engineers and contractors. I wish to paraphrase certain statements which I find in your issue of July, 1924, page 51. I quote verbatim with the exception of substituting the word *contractor* where the word *engineer* occurs in your publication.

"The writer believes after 25 years of selling *contracting* services, that conditions are greatly improving, and rapidly will improve if *contractors* themselves will adopt the following practice:

"Place their own high estimate upon the value of their service and standing in the community.

"Decline to submit sealed proposals for *contracting* services, and frankly advise cities against this policy.

"Emphasize the fact that 'Good *contracting* and cheap *contracting* are not companions.'

"Use every effort to enlighten municipal officials that *contracting* is not a commodity to be bought and sold at so much per.

"Encourage *contracting* organizations, clubs and societies to disapprove and criticize *contractors* who belittle their profession by participating in a sealed proposal competition for services."

The above ought to be sufficient to show that any such attempt to restrict competition among engineers is unethical. To show the seriousness of this error I cite a few of the statutes:

"Any person who shall directly or indirectly engage in any scheme, design, understanding, plan, arrangement, contract, agreement or combination to limit, restrain, retard, impede, or restrict bidding for the letting of any contract for public or private work, or in any manner combine or conspire to stifle or restrict free competition for the letting of any contract for private or public work, shall be deemed guilty of a misdemeanor, and upon conviction shall be fined in any sum not exceeding five thousand dollars, to which may be added imprisonment in the county jail or workhouse for a term of not more than one year in the discretion of the court or jury trying the cause."—Indiana, 1907, page 492.

This statute will not be avoided by contending that a contract for engineering services is not a contract for public or private work.

The State of Illinois has the following statute bearing on this same practice:

"If two or more persons conspire or tive committee of any society or oragree together, or the officers or executive committee of any society or organization or corporation, shall issue or utter any circular or edict, as the action of or instruction to its members or any other persons, societies, organizations, or corporations, * * * or shall post or distribute any written or printed notice in any place, * * * to prevent competition in the letting of any contract by the state or the authorities of any county, city, town, or village, or to induce any person not to enter into such competition, or to commit any felony, they shall be deemed guilty of a conspiracy; * * * and every person convicted of conspiracy at common law shall be imprisoned in the penitentiary not exceeding five years, or fined not exceeding $2,000 or both."—Illinois, Sec. 3547, Call—1916—amended 1919—page 425.

Under certain conditions the Sherman Anti-Trust Law may apply.

It reads in part:

"Section 1. Every contract, combination in the form of trust, or otherwise, or conspiracy in restraint of trade or of commerce among the several states or with foreign nations, is hereby declared to be illegal. Every person who shall make any such contract or engage in any such combination or conspiracy shall be deemed guilty of a misdemeanor, and on conviction thereof, shall be punished by fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both said punishments in the discretion of the court.

"Sec. 7. Any person who shall be injured in his business by any other person or corporation, by reason of anything forbidden or declared to be unlawful by this act, may sue therefor in any circuit court of the United States in the district in which the defendant resides or is found, without respect to the amount in controversy, and shall recover three-fold the damages by him sustained, and the costs of suit including a reasonable attorney's fee."

Labor unions have been sued under this statute and judgment recovered as in the Danbury Hatters' case, and have since tried to escape criminal liability by an Act of Congress that no part of the appropriation for the Department of Justice shall be used in prosecuting labor unions or farmers' organizations.

I have participated in numerous competitions for engineering services and have never known one to be conducted on the basis of selection for price alone. They offer convenient methods for presenting the advantages of superior services, and I have known the award to go again and again to the highest bidder.

Engineers themselves are most to blame for competitions on a price basis, for many of them contend that there can be no real competition unless all bidders are bidding on the same identical thing. The courts rarely hold that this is true unless the law specifically requires it.

The remedy for such competitions, if a remedy is necessary, is not to advocate violation of the statutes against restraint of trade, but to compete on the basis of service.

Very truly yours,

DANIEL B. LUTEN,

Indianapolis, Aug. 7, 1924.

DIGEST OF COURT DECISIONS ON ZONING

(Editor's Note: The following digest of court decisions throughout the United States on the subject of zoning was compiled by H. A. Postlethwaite, Assistant Secretary of the League of California Municipalities, and City Attorney for the cities of San Bruno and Sonoma, Calif. It was published in Pacific Municipalities for July, 1924.)

In re. Opinion of the Justices (Mass.) 127 N. E. 525.

An ordinance segregating commercial buildings from residences is valid. A zoning law is not invalid on account of provisions for the aesthetic element where the dominant aim in respect to establishment of building districts has a primary regard to other factors which are lawfully within the police power.

State ex rel. Civello v. City of New Orleans et al. (La.) 97 So. Rep. 440.

It is sufficient, for the exercise of the police power in the matter of city planning and zoning, that the Constitution does not forbid it. General principles of zoning upheld. A grocery store, gasoline filling station, vegetable and fruit stand and an ice plant may properly be excluded from a residential district.

State ex rel. Carter v. Harper etc. (Wis.) 196 N. W. 451.

A comprehensive zoning ordinance dividing the City of Milwaukee into residence districts, local business districts, commercial and light manufacturing districts, and industrial districts, held a valid exercise of the police power.

Brown v. City of Los Angeles, 183 Cal. 782.

It is a valid exercise of the police power to create zones within some of which it is legal and others it is not legal to establish undertaking parlors.

Lincoln Trust Co. v. Williams Bldg. Corp. (N. Y.) 128 N. E. 209.

An ordinance establishing "residence," "business" and "unrestricted" districts is a valid exercise of the police power; and such an ordinance does not constitute an encumbrance upon real property.

Salt Lake City v. Western Foundry & Stove Repair Works (Utah) 187 Pac 829.

The creation of a residence zone wherein foundries are excluded, held to be a valid exercise of the police power, and does not violate any rights guaranteed by the organic law.

The city had a right to exclude foundries from a particular section of the city, although there were other sections of the city where similar conditions prevailed and in which no such prohibition existed.

City of Des Moines v. Manhattan Oil Co. (Iowa) 184 N. W. 823.

A state may directly or through a delegation of authority to municipalities, adopt and enforce reasonable regulations concerning the use and occupation of real estate in cities and towns.

An ordinance establishing a restricted residence district and prohibiting the erection of buildings therein other than residences, school houses, churches, etc., is a valid exercise of the police power.

Cliffside Park Realty Co. v. Borough of Cliffside Park (N. J.) 114 Atl. 797.

A city under the authority of proper state statutes, may, in the exercise of its police power, enact a zoning ordinance to promote the public health, safety and general welfare.

Ware v. City of Wichita (Kan.) 214 Pac. 99.

An act of the legislature which authorizes the creation of city planning commissions, and an act which authorizes cities to establish districts or zones within their corporate limits and to regulate the use of property and the construction of buildings therein, are not unconstitutional.

A city ordinance, adopted pursuant to express statutory authority, which forbids the construction of a business building in a residence district, is a valid exercise of the police power, and does not violate any provision of state or federal Constitution.

Commonwealth v. Atlas (Mass.) 138 N. E. 243.

A statute providing that a city "may, for the prevention of fire and the preservation of life, health and morals, by ordinances * * * consistent with law and applicable throughout the whole or any defined part of its territory, regulate the inspection, materials, construction, alteration, repair, height, area, location, and use of buildings and other structures within its limits," is a constitutional and valid exercise of the police power.

A section of a building ordinance vesting certain discretion in the building inspector is void as not coming within the scope of the statute.

Cohen et al. v. Rosedale Realty Co., Inc., (N. Y.) 199 N. Y. S 4. (Affirmed 199 N. Y. S. 916.)

"It must be conceded that the regulation of the building zone resolution comes within the recognized police power of the state."

Schait v. Senior et al. (N. J.) 117 Atl. 517.

An act which authorizes a town in the exercise of its police power, to enact a zoning ordinance to promote the public health, safety and general welfare, is constitutional.

A portion of a zoning ordinance which prohibits garages for more than five motor vehicles within a radius of 200 ft. of any church or public library, is a reasonable regulation touching public health, safety, and general welfare, and is a valid exercise of the police power.

Ex parte Montgomery, 125 Pac. 1070, 163 Cal. 457.

A city has a large discretion in enforcing such police measures as ordinances prohibiting the operation of industrial establishments, etc., in a residence district.

It is a constitutional exercise of the police power to prohibit the operation of a lumber yard in a residence district.

Ex parte Quong Wo, 118 Pac. 714, 161 Cal. 220.

An ordinance dividing a city into residence and industrial districts may competently confine lawful occupations to industrial districts whenever such restrictions may reasonably be found necessary to protect the public health, morals, and comfort.

Since all property is held subject to the lawful exercise of the state's police power, an ordinance prohibiting laundries within a certain district of a city, denominated the "Residence District" would not be invalid because in a particular case it prohibited the continuation of a laundry business in premises in which there was an unexpired leasehold interest for such purpose.

Judicial notice can not be taken that there has been unjust discrimination in excepting small parcels of land, or even single lots, entirely surrounded by residence territory, from a residence district and adding them to the industrial district, the presumption being in favor of the legality of the action of a legislative body.

People v. Walsh (N. Y.) 199 N. Y. S. 534.

New York City building zone resolutions have the force and effect of statutes.

Julian v. Golden Rule Oil Co. (Kan.) 212 Pac. 884.

Express legislative authority is necessary to give cities the power to create zones or restricted districts, and an ordinance passed without such authority is void.

Allen v. City of Paterson (N. J.) 121 Atl. 610.

Exercise by a city's board of zoning appeals of its power, conferred by city zoning ordinance and recognized by state law, to vary from strict compliance with the ordinance, so as to prevent unnecessary hardship or injustice to property owners, by permitting one to build a garage 7½ ft. from the street, his lot not permitting its construction 14 ft. therefrom in strict compliance with the ordinance, and his neighbor having built before passage of the ordinance, can not be interfered with or controlled by the courts, by certiorari, there not being involved any invalidating element of unreasonableness, fraud or mala fides.

Franklin Contracting Co. v. Deter et al. (N. J.) 122 Atl. 600.

The provisions of a zoning ordinance excluding factories from a residence district are valid.

Boland et al. v. Compagno et al. (L. A.) 97 So. 661.

The provisions of a zoning ordinance excluding any business on a particular street between certain cross streets, except a drug store, boarding house, apartment house, hotel, or bank, held valid, and not to make arbitrary discrimination, or deny the equal protection of the law.

Myers et al. v. Fortunate (Del.) 110 Atl. 847.

The provisions of an ordinance that no permit shall be granted for erection of a public garage in a residential district within 40 ft. of the building line of adjoining property owners, unless their written consent has been filed with the building inspector, held not unconstitutional as a delegation of legislative, nor as unreasonable, arbitrary and oppressive.

Hadacheck v. Sebastian (Cal.) 239 U. S. 394.

A municipal ordinance enacted in good faith as a police measure, prohibiting brickmaking within a designated area, does not take without due process of law, the property of the owner of a tract of land within the prohibited district although said land contains valuable deposits of clay suitable for brickmaking and which can not be profitably removed.

The ordinance is a valid exercise of the police power, does not deny the equal protection of the laws and is not dis-

criminatory or in restraint of trade.

Spann v. City of Dallas (Tex.) 235 S. E. 513.

An ordinance prohibiting the construction of any business house within what the ordinance denominates a residence district, except with the consent of three-fourths of the property owners of the district, and on the building inspector's approval of the design of the proposed structure, held void and an improper exercise of the police power.

The ordinance defined a residence to be any part of the city where there are more dwelling houses than business houses within a radius of 300 ft. from the place where any business house is proposed to be constructed.

The court denounced strongly the unbridled discretion vested in the building inspector.

This ordinance was not based upon any express provision of charter or state enabling act.

State v. McKelvey (Mo.) 256 S. W. 474 and 495.

A zoning ordinance of the City of St. Louis dividing the city into five zones or districts and defining the uses permitted in the respective districts, held invalid, unconstitutional and an improper exercise of the police power.

The ordinance was not based upon any express provision of charter or state enabling act. However, the majority opinion indicates that a state enabling act would be declared void.

The majority opinion in this case is concurred in by three justices and a concurring opinion written by a fourth. A strong dissenting opinion setting forth the recent and progressive law on the subject and upholding the validity of the ordinance is concurred in by three justices.

City of St. Louis v. Evraiff (Mo.) 256 S. W. 489.

This case is to the same effect as State v. McKelvey (supra), except that there is an indication that the existence of express delegated authority enabling the city to enact a zoning ordinance might possibly change the result.

Handy v. Village of South Orange (N. J.) 118 Atl. 838.

An amendment to a zoning ordinance restricting buildings in residence districts to single family dwellings, held invalid.

The court stating: "We think the ordinance is bad * * * because to forbid the building of a house for two families in the entire village is not the proper exercise of the police power; * * * The ordinance does not regulate the size of the lot, nor how far the buildings must be separated. The restriction is a blanket one * * *."

The ordinance in question divided the municipality into only two districts, namely, business and residential.

Byrne v. Maryland Realty Co. (Ind.) 98 Atl. 547.

An ordinance providing that no dwelling house shall be erected within a defined section of Baltimore City, unless such dwelling house shall be constructed as a separate and unattached building, and if of frame construction, to be at least 20 ft. apart, and, if of stone or brick construction, at least 10 ft. apart, is unconstitutional and is an attempt to invoke the police power for purely aesthetic purposes.

Stubbs v. Scott (Ind.) 95 Atl. 1060.

A permit to erect a store building may not be refused merely because it is in a residential neighborhood and does not conform to the character of buildings immediately surrounding. No zoning ordinance was involved in this case.

Romar Realty Co. v. Board of Commissioners of Borough of Haddonfield, 114 Atl. 248.

An ordinance providing that on a certain street no building of any kind less than two stories high shall be erected within 80 ft. of the property line is invalid.

State v. Edgcomb (Neb.) 189 N. W. 617.

The provision of a zoning ordinance restricting the area of buildings erected in a certain district to 25 per cent of the area of the lot, held to be unreasonable and void.

A dissenting opinion holds that the regulation is in keeping with the locality and bears a proper relation to the promotion of the public welfare.

City of St. Louis v. Dorr (Mo.) 41 S. W. 1094.

A statute authorizing a municipality to exclude businesses from property fronting on a boulevard, held void as an exercise of the police power.

The statute was held to be an attempt to amend the municipal charter in a manner forbidden by the state constitution.

State v. Houghton (Minn.) 158 N. W. 1017.

An ordinance prohibiting businesses in a certain designated residence district held invalid as an exercise of the police power.

Two justices concur in a strong dissenting opinion.

Willison v. Cooke (Colo.) 130 Pac. 828.

An ordinance excluding businesses from a certain defined residence district unless the majority of property owners within the block consent, and providing that buildings must be set back to an average set back line, held invalid as an exercise of the police power.

The court stated: "It will be observed that there is no express authority conferred upon the council to pass ordinances embracing the conditions and restrictions imposed * * *; and hence it is only by virtue of the incidental powers with which the municipality is vested to pass police regulations that it assumes to act in passing the ordinance in question."

Clements v. McCabe (Mich.) 177 N. W. 722.

A zoning ordinance of the City of Detroit held within the scope of the police power, but void in the absence of express constitutional or legislative authority.

State v. City of Montgomery (West Va.) 117 S. E. 888.

A refusal to issue permit for a garage held illegal where there was no ordinance in force regulating garages.

Fitzhugh et al. v. City of Jackson et al. (Miss.) 97 So. 190.

An ordinance prohibiting the conduct of any business in a residence district held not within the police power of the municipality. In this case the ordinance was not based upon any enabling act. The court quotes with approval language from the case of Town of Clinton v. Turner, 52 So. 261, as follows: "Municipalities act under limited powers, and must find authority clearly given in the law, and, when so found, they must follow the law."

Ignaciunas v. Risley (N. J.) 121 A. 783.

The provisions of a comprehensive zoning ordinance of the City of Nutley prohibiting a store building in residential districts, held not a valid exercise of the police power.

Keavey v. Randal (N. J.) 122 A. 379.

An ordinance requiring the city council's consent to erection of a garage held discriminatory as enforced.

Blakeslee Inc. v. Mayor etc. of Jersey City (N. J.) 112 A. 593.

Holding that the enabling act of the State of New Jersey does not permit the zoning of a district "strictly for residential purposes."

In re Throop, 169 Cal. 93.

A municipal ordinance, which after dividing the municipality into different districts, prohibits the maintenance of a stone crusher in one of such districts containing upwards of two thousand acres, a greater part of which is sparsely settled and 500 acres of which is admittedly unimproved, undeveloped, and practically uninhabited, is unreasonable and void.

Wilson v. Edgar (Cal.) 222 Pac. 623.

The saving clause of a zoning ordinance, which provided that "in any building or premises any lawful use existing therein at the time of the passage of this ordinance may be continued therein although not conforming to the regulations of the district in which it is maintained," held not to authorize the conducting of a non-conforming business in a building other than that business to which it was devoted at the time of the enactment of the ordinance.

State v. Harper (Wis.) 196 N. W. 451.

A zoning ordinance of the City of Milwaukee is not unreasonable in that it prohibits the enlargement of an existing business building in a residence district.

Cherry v. Isbister (N. Y.) 234 N. Y. 607, 138 N. E. 465.

A zoning ordinance passed after petitioner had filed his application to build and after he had commenced proceedings to compel the issuance of a permit, which prohibited the erection of a building of the kind specified on the plot in question, was valid and effectual to bar the issuance of a building permit. To the same effect: In re Cherry, 193 N. Y. Supp. 57, 196 N. Y. Supp. 920.

The following inaccessible cases have been cited on the subject of zoning but are not covered in this digest. They are: State ex rel Morris v. Osborn, 22 Ohio N. P. (N. S.) 549, 31 Ohio Dec. 98, 197; State ex rel Dantzig v. Durant, 21 Ohio Law Bull. & Rep. 395 (C. A. Ohio 1923); Motor Home Inc. v. Hedden (Super. Ct. Los Angeles Co., Calif., Nov. 14, 1923) unreported; Kahn Bros. v. City of Youngstown (C. P. Ct. Ohio, 1923) unreported; Kosloy v. Quigley (Sup. Ct. N. J. Nov. 1922) unreported; Ambler Realty Co. v. Euclid Village, 21 Ohio Law Bull. & Rep. 607 (U. S. Dist. Ct., N. D. Ohio).

EXPERIENCE WITH FORCE ACCOUNT CONSTRUCTION AT LYNCHBURG, VA.

By Edward A. Beck, City Manager, Lynchburg, Va.

(Editor's Note: This magazine believes in the contract system of doing public work but desires to place information and arguments on both sides of all important subjects, in our field, before our readers.)

Lynchburg constructs with its own forces the usual run of all public improvements with the exception only of sidewalk pavements.

The city is fortunate in having a citizenship which not only believes in, but has always supported a practical application of the "More business in government" slogan, so that when this change in municipal practice was made it was met with a large measure of that friendly and constructive criticism which not only bespeaks an interest in, but is helpful toward the success of, any experiment. Of course, as would be expected, some criticism of a different character was also forthcoming. Naturally, municipal contractors and their associates did not enthusiastically welcome the change in policy. Some of the arguments advanced in opposition were pertinent, others were not so well founded, and none was unanswerable.

It was suggested that it was unfair for the city to compete with private business and deprive taxable enterprises of profits accruing from public improvements. As a matter of fact, there is no competition, although a potential source of profit is removed. On the other hand, it is manifestly unfair to the taxable citizenship as a whole to give a selected few an opportunity for profit denied to others and which must be paid in the tax bills of many.

Again it was said that the building of public improvements by municipal forces would lack the incentive for prompt and energetic execution of work characteristic of the successful contractor, and thus result in much public inconvenience due to prolongation of the construction period. This, of course, is an accusation of governmental inefficiency, which, if true, is equally applicable to every public function. If this argument were founded on fact, then it would seem that sound business policy would demand a discontinuance of those municipal operations which have almost universally been accepted as a proper sphere of governmental activity. Street sweeping and refuse collection are examples of services which can be performed under contract although they are now rarely handled in that manner.

Probably the most plausible argument against the policy under discussion is that work so handled would be more costly than when performed by private agencies organized and equipped for that purpose. This argument is supported by the experience of a number of cities where emergency improvements have been undertaken by their own forces without either an adequate organization or necessary equipment. As a matter of fact, organization and equipment, plus financing, are controlling factors in the success of any enterprise. There is no good reason why a city can not secure both an organization and equipment equal to that of any contractor. Certainly most cities have an advantage over the average municipal contractor when it comes to ability to finance any operation it undertakes.

Careful consideration of this argument develops the conclusion that it is not alone fallacious, but, to the contrary, a city has at least the potential ability to construct public works at an expense not only less than would be required under the contract system, but even less than the contractor's actual cost.

In support of this statement let me offer the following facts, which I believe are beyond dispute:

1st: Both a city and a contractor have the same field from which to recruit an organization.

2nd: Both have the same markets from which to procure equipment.

In these two respects neither has an advantage.

Purchasing

Now as to materials entering into the actual improvement. While both parties have available the same markets, yet the city has certain definite and substantial advantages:

1st: Its credit is established, which insures prompt deliveries.

2nd: Its financial resources are sufficient to enable it to take advantage of cash discounts, whereas the average contractor pays his bills on receipt of monthly estimates from the city. Last year Lynchburg benefited over $2,500 from cash discounts on material purchased for its public improvements.

3rd: With their credit beyond question, cities can purchase various materials at a lower gross cost than can the average contractor.

4th: Freight rates favor direct deliveries to municipalities on certain classes of road-making material. In Virginia, a reduction of 10 cents per ton is allowed from the regular rates on shipments originating within the state. On last year's construction, Lynchburg received a credit from this source of exactly $617.70.

Other similar savings might be also mentioned. Although the amounts are comparatively small in each instance, yet the aggregate is large.

Operating Expenses

In the matter of operating expense, the city likewise has many advantages which make it potentially possible to carry on construction at costs below those of a contractor:

1st: In that it is necessary to maintain general city accounting and purchasing organizations the municipal construction department need not carry a charge for these essential operations which a contractor must enter against his improvement costs. It is true that these departments cost the city money, but in the case of Lynchburg, at least, the expense is the same, regardless of whether or not it handles its own work.

2nd: The activities of a municipality are so diversified that its organization can be continuously employed without encountering an item of expense as does the contractor who must maintain at least a skeleton organization in idleness when jobs are not at hand.

3rd: Lynchburg operates a shop for the maintenance of all its equipment. In this, there is not only a saving in the actual cost of work below that which a contractor would pay if he patronized a commercial shop as many do, but there is even a greater return through controlling the shop routine so that no time is lost by idle equipment waiting its turn before repairs can be started.

4th: The city saves the costs of bonds customarily required of the contractor and which he must charge against the work.

While these advantages relate only to actual improvement costs, the city reaps also a direct financial return when it does its own work through eliminating a substantial portion of inspection expense required under the contract system.

Theory and Practice

Theoretically, there is no doubt that it is economy for a municipality to construct its own improvements, but it has been the experience of the speaker that work of any magnitude can not be effectively and efficiently handled by the so-called Street and Sewer Departments under their usual plan of operation in most cities. These departments are ordinarily established with maintenance alone in mind. Attempts at a combination of construction and maintenance in one organization generally result in more expensive construction than when handled by a crew especially organized for that purpose. Incidentally, it might be remarked that it also happens under these conditions that maintenance is treated as a secondary consideration leading to neglect of that important service. More expensive construction costs and less effective results logically follow the transfer of labor to construction for short periods after it has become accustomed to working in the loosely-organized groups common to maintenance or patch work, and which is ordinarily selected for work of that character. On the other hand, maintenance suffers from any attempt to concentrate large amounts of labor on construction work, which depletes the regular crews beyond that necessary to carry on routine repairs and patching, and which must be more or less a continuous operation to secure results.

Department of Public Works

Following this conclusion, Lynchburg established a Department of Public Works essentially to assume jurisdiction over all public improvements, and in this department is now operated a Bureau of Construction for the sole purpose of building streets and sewers with its own equipment and men.

Paving Work

In January, 1921, prior to the creation of the Construction Bureau, bids were secured on alternate types of paving in connection with the improvement of one of the city streets. These bids were rejected because of excessive cost and the work re-advertised under specifications limiting the improvement to an asphalt-filled vertical fibre brick surface on a 5-in. concrete base. In response to this advertisement, somewhat lower figures were obtained on Feb. 21, 1921. However, the low bid of $64,372 was $12,182 in excess of the city's estimate of the cost of the work if done by municipal

forces. The Bureau of Construction was then organized and authorized to proceed with the improvement, which was completed at an expense of $45,208.23, a net saving of $19,163.77, or more than 42 per cent of the cost. Were a value placed on "Extras," for which a contractor would have been entitled to compensation, and were there eliminated certain items of expense occasioned by keeping the street open almost continuously to traffic, a convenience which would not have been ordinarily provided by contract work, the saving would have been appreciably greater.

However, good management on the part of the Construction Bureau was not responsible for all of this saving, as a small percentage was due to some decline in the labor and material market which took place after the commencement of the work; but had the improvement been awarded by contract, the contractor, and not the city, would have been the beneficiary of these declines. This suggests a question. If prices had substantially increased, would not the city have been loser? The answer is no, for the reason that it is customary for vendors of material to guarantee against rising market quotations furnished by them for a particular job. Be that as it may, comparative costs for subsequent work under stable market conditions show equally satisfactory returns.

Sewer Work

Construction by municipal forces return economies in sewer installation even to a greater extent than in paving construction. It is obvious that the uncertainties connected with the former call for a greater margin of safety on the part of the contractor in estimating costs.

Even disregarding the saving in cost, it has been Lynchburg's experience that municipal construction of improvements would be justified by other considerations.

1st: The city has direct control of the improvement whereby it is possible to arrange the work with due regard to public convenience, to which a contractor ordinarily gives little, if any, consideration.

2nd: The city can harmonize all types of construction, such as sewers, gas lines, and water installation, which may not be and usually are not a part of a general contract.

Fundamentals

While this discussion has been largely general in its application, yet it must be understood that certain fundamental conditions within the control of each municipality are essential for successful operation.

1st: There must be adopted a program of sufficient magnitude to insure continuous operation of the construction organization. The reasons for this are obvious. In the City of Lynchburg, sidewalk improvements are largely dependent upon the wishes of individual property owners who contribute a substantial portion of the cost by agreement. Accordingly, the city has no control over the amount, nor can it time the periods for such construction. Hence, the expense of maintaining an organization for that purpose, when it can be engaged only at infrequent intervals does not result in economy. Therefore, sidewalk construction is not included in the activities of the Municipal Construction Bureau.

2nd: Ample authority must be provided to insure prompt action in all matters affecting the prosecution of the work, particularly in questions of rates of wages, and the purchase of supplies and materials.

Conclusion

In conclusion, let me say that during the two seasons that the practice of constructing public improvements by municipal forces has been in operation in Lynchburg, there has been expended over $400,000 in capital betterments and the results have been so satisfactory in every respect that a return to the old contract system would be met with a decided and strong opposition.

The foregoing article by Mr. Beck is from "Engineers and Engineering" for July, 1924.

PUBLIC UTILITY REGULATION IN INDIANA

(Editor's Note: The following statement, recently issued by the Indiana Public Utility Association, is not only an interesting but a fair treatment of subject that has been much discussed. While relating primarily to Indiana conditions it is of general interest and application.)

The Public Service Commission of Indiana was created in 1913 by an Act of the Legislature, in which its powers,

duties and limitations were strictly defined. Since that time the Public Service Commission, as an institution, has been subjected to attacks by the press, by political candidates, by groups of citizens, by individuals, and by the utilities themselves. The repeal of the Act creating the commission has been sought from some source or other at some sessions of the Legislature since the war, when economic conditions underwent an upheaval. There are few people who are interested in the subject of public utility regulation but who have heard it said repeatedly that the establishment and perpetuation of the commission was a "boon" to the public utilities, and its perpetuation was sought by and only desirable to them.

The Commission Law

A brief statement of the history of the commission form of public utility regulation, some of the provisions of the Indiana Act, and its benefits to the people of Indiana, is at this time particularly opportune. Public service commissions, or commissions whose function it is to regulate the rates, securities, service, and practices of public utilities, did not spring into existence overnight, nor at the behest of the public utilities. Theretofore, regulation had been left largely to cities, and there grew up a widespread demand that public utilities be properly regulated as to rates, service, securities, etc. Regulation of utility rates through franchises or ordinances was notoriously unsatisfactory. Local politics necessarily could not be kept out of the utility issues which constantly arose. The long-term franchise, if it fixed rates, was inflexible, and hence no rapid or reasonable readjustment of rates could be made. If the cities had been legally empowered scientifically to fix rates up and down, they would have been, and still are, unequipped to study the complicated questions which necessarily arise. The conditions today are widely different than they were a decade ago, particularly as respects the electrical industries, for at that time electricity was largely generated and distributed within a local area, whereas, today, the same company, the same system, and the same source of power, supplies dozens and sometimes hundreds of scattered towns and cities.

A method of regulation which naturally appealed to city officials who believed that rates for a utility were too high was by the creation of artificial competition between utilities. To curb a public utility which was in disfavor, a second and competing company was urged to come into existence. The result in every case was a wasteful duplication of plant and equipment. Competition as a method of utility regulation was, and necessarily always will be, economically unsound. The results of this method are so well known that instances need not be cited.

Maximum rate statutes, passed by the Legislatures, were once a fad; these declared a rate beyond which the utility could not charge. Their weaknesses were manifest; they were unscientific and arbitrary, and they aplied to all companies the same terms and rates, although operating under wholly different conditions and rendering service of widely different quality.

Briefly, these three methods of attempting to regulate public utilities have been used in Indiana and elsewhere. None of them is satisfactory; none of them will be more satisfactory in the future; but, on the other hand, because of the rapid development of utilities and the increasing demands made upon them, these old and unsatisfactory methods would be still more unsatisfactory.

There is always heard the demand, made with great emphasis, that what is highly desirable is "home rule" of public utilities; that the way to bring rates down is to throw the regulation of public utilities back into the hands of the municipalities; that the Public Service Commission Act does not protect the public; that the Public Service Commission has continually raised rates, and that they will always continue to do so. Let us look at the provisions of the Public Service Commission Act which were designed to and certainly can protect the public as to rates, the thousands of investors in public utilities in the soundness of their investments, and the hundreds of thousands of consumers as to the quality of their service.

The Act empowers the Public Service Commission to fix reasonable rates for a public utility. These rates should be sufficient to pay the fair and proper operating expenses, cover the inevitable depreciation upon the plant, pay the taxes from which a utility can not escape, and pay a reasonable return upon the fair value of a utility property—the values being found after applying methods which have been made mandatory by the Supreme Court of the United States. The Public Service Commission

Act in theory discourages competition between utilities serving a given locality, if the one already in the field is serving adequately as to quality and amount of service. The utilities, by the provisions of the Act which permitted them to surrender any existing franchises and to receive by operation of law what is called an "indeterminate permit," were relieved of many burdens placed upon them by local franchises. But these burdens, of course, were really carried by the consumers of the utility or by the general taxpayers, so the imposition of burdens on the utility reacted unfortunately upon the utility's patrons.

This, in a nutshell, is the Public Service Commission Act, so far as its so-called "boon" to the utilities is concerned.

Patron and Investor

Let us look at the Act from the standpoint of the people of Indiana, the consumers of the utilities, and the investors in the utilities. In the first place, the Act leaves to the lities original jurisdiction over matters of extensions and service. Within reasonable limitations, the cities can require the utilities to make extensions which, in their opinion, are necessary to the proper service of their citizens, and can specify the quality of the service to be rendered. From the cities' jurisdiction over these matters there lies an appeal to the commission, but the cities have the first word.

The matter of the regulation of rates is no longer in the hands of the cities. It is, however, inaccurate to say it ever had been, because what was actually done before the creation of the commission, was that the city and the utility entered into a franchise contract providing for permission to the utility to use streets and alleys for a certain length of time, in many instances specifying the rates which alone could be charged. The cities were given the power to contract in this matter; this is not, however, the same as the power to regulate. The power to regulate the rates of a utility within a reasonable and non-confiscatory limitation has always been in the state. The old franchise contract fixing rates, we may assume, was binding upon both parties until mutually modified or rescinded. One of the parties whose name did not appear was the State of Indiana. Thus the real party which entered into the contract with the utility through its agent, the city, was the State. When the State decided to offer the utility a different kind of a contract or permit, it took no fundamental rights away from the cities, but merely exercised the power which temporarily it had given to the cities. Rates are now based, as said above, primarily upon two factors, expenses of operation, including taxes and depreciation, plus a fair return upon a fair value and on nothing else.

Utilities are held down to a rate of return which in theory is only sufficient to enable it to receive interest on its investment. It is unable to make in any period a "killing," and therefore, since there are no fat years, it can not stand any lean ones. If the commission has determined that a certain rate is fair and reasonable, the right of appeal to the local Circuit Court is left to the cities or to the consumers, whereby the local judge will hear the evidence, and if, in his opinion, the commission has been in error and has granted rates which are too high, he may set aside the order or enjoin its enforcement. The fact that this right of appeal is not generally understood has been the cause of expressed dissatisfaction. Delay incident to the appeal has, by the terms of the Act, been removed, for the case is put upon the advance docket of the court, thus assuring a speedy rehearing, if the rates fixed by the commission may appear to be too high to the patrons.

An investigation by the commission of the rates of a utility may be demanded by a small number of patrons at any time by the provisions of the Act.

The utility also is required to provide service which meets a certain standard set by the commission, which maintains a service department to take care of consumers' complaints. This department is equipped and experienced in handling complaints and in eliminating the cause for others. No cities, except the larger ones, could afford to undertake this sort of service.

Before the Public Service Commission Act, the utilities were not regulated as to the issuance of their securities, except by their charter provisions. No one was authorized to maintain a reasonable relationship between the securities and the value of their properties. Today it is the policy of many utilities to encourage investment in their securities by the small investor, particularly their consumers and their employes.

The Public Service Commission Act does not permit the issuance of a single

share of stock or a single bond before the utility has the approval of the commission, which is obtained only after a scrutiny of its property by the Engineering Department of the commission, and of its books and records by the Accounting Department. The utility is compelled to keep its books open to the agents of the commission, and to submit its expenditures for check to the commission's engineers. The utility is compelled by the Act to keep its books according to a prescribed uniform system of accounts. Its books are open to audit and public inspection. This feature of the Act alone gives the public the benefit of knowing at all times the true financial status of the utility. Prior to the passage of the Act this was not possible, for no one could compel the utility to open its books to public gaze. In addition, special and annual reports from the utility are required by the commission. These latter enable the commission to keep in touch all the time with the finances of the utility.

These are the most effective safeguards conceivable to the thousands and thousands of investors in public utility securities. The securities regulation is of direct and inestimable advantage to the public, because it protects the investor and prevents the over-capitalization and inevitable weakening of the utility. The thing that is to be desired by the consuming public is that the utility rates be fair, that the service be good and dependable, and these are directly connected with the supervision of securities by a centralized body, capable of studying them intelligently. It might be said in passing that rates are not based upon outstanding securities, but only upon the fair appraised value of the property.

The Utility's Position

Before the Commission Act was passed, utilities could purchase each other, consolidate or merge at will and upon any basis they chose. This is no longer possible without the approval of the Public Service Commission, after an investigation, and only upon the terms fixed by the commission. This safeguard in the interest of the public is similar to that of, and of course is related to, the supervision over securities. Referring to the other side of the franchise contract, which was referred to above, the permission to the utility to surrender its franchise for an indeterminate permit was not granted by the Act to relieve the utility from a hard contract, for when the utility gives up its franchise it agrees thereby to sell its property to the municipality upon demand at a fair figure to be fixed according to law.

The Public Service Commission Act prevents discriminatory practices. All consumers falling within the same class must be given equal rates. Free service is abolished and the commission has power to enforce penalties for the violation.

The Public Service Commission Act requires the utilities to keep their books and records open for the inspection and audit at any time by the Public Service Commission of Indiana. This obligation upon the utilities was put into the Act so that an effective check might be had upon the expenditures of a utility by way of operating expenses and also for capital additions. This provision is distinctly of benefit to the public.

To review in detail the Public Service Commission Act of Indiana and to attempt to set out minor provisions which might be called beneficial to the utility on the one hand, or beneficial to the public on the other, would be purposeless, for it does not follow that what is beneficial to the utility is damaging to the public.

Benefits of Regulation

In brief, however, and by way of summary, it can be said that benefits accruing to the utility from the Act are these:

1. The attempted assurance to the utility of reasonable rates, based upon reasonable operating expense and a fair value.

2. The discouraging of competition between utilities of the same kind, operating in the same locality where one is capable of rendering the service necessary.

Helpful to Public

On the other hand, the Act is of distinct benefit to the public and to the consumers of the utilities in Indiana:

1. By keeping the rates of the utilities within reasonable bounds as stated above.

2. By preventing the over-issuance of securities or dangerous over-capitalization.

3. By regulating sales, consolidations, and mergers, by and between public utilities.

4. By the prohibiting of free service or discriminatory rates.

5. By the provision of an agency for

the regulation of the quality of service rendered by the utility.

6. By the provision of a method whereby the rates of a utility can be investigated promptly at any time upon the demand of a certain number of the patrons of a utility.

7. By giving the right to a municipality to purchase any utility property if it so chooses, where the utility has surrendered its franchise for an indeterminate permit.

8. By the centralization in the hands of a Commission, properly equipped with experts, of the work of investigating rates, service, security issues and practices of the utilities.

9. By the requirement that the utility's books be kept open for audit and inspection and the furnishing of special and annual financial reports.

These, in brief, are the chief benefits from the Act which accrue to the people of Indiana.

It should be remembered, however, that what is of a restrictive nature upon the utilities is not always unwelcome to them, nor should it be forgotten that it is not beneficial to the public to harm the utility. What is good for one is generally good for the other. Because a utility has some advantages from the Public Service Commission Act, it does not follow that these advantages are at the expense of the public. The Public Service Commission Act is simply designed to keep the rates of a utility at a reasonably proper level and to restrict the utilities from doing anything improper, which ultimately would unfairly raise the rates or impair the service.

THE CITY AND THE GAS TAX

By A. M. Wilson, City Manager, Colorado Springs, Colo.

(Editor's Note: The present article by Mr. Wilson is a discussion of the article entitled, "Apportionment of Motor Vehicle Fees, Gasoline and County Road Taxes for Use on City Streets," by Don C. Sowers, executive secretary, Colorado Municipal League, published on pages 3-7 of the July (1924) number of Municipal and County Engineering.)

Building and maintaining streets is a problem with all municipalities. It would not be so difficult if the appropriations for that purpose were sufficient to make even the necessary improvements. Nearly all of the departments of the city have a definite fixed amount which can not be reduced without serious impairment of service. In making up the annual budget it is quite impossible to appropriate sufficient for all departments without increasing the tax levy. Taxes are already very high and it is necessary to keep the appropriations down to the minimum. Street maintenance is an indefinite item, and when more money is required for some special purpose and there is no other place to get it, the street department fund usually suffers a cut.

Since the automobile has become a public necessity and is so generally used, more people are riding and notice the defects in the streets, consequently the department is subject to more criticism and more complaints are filed against it than any other department of the city. The demand for more improvements and more maintenance was never so great and is increasing rapidly, and those in authority must in some way meet the demand. How are we going to do it?

The easy way would be to increase the levy, as there would be no more expense for collection.

Mr. Sowers has suggested other methods. He has told us the average license fee collected in Colorado is $6.10. This amount is less than one-half the average fee collected in the United States. A substantial increase would be justified. Double the license fee, if necessary, and give all the increase to the incorporated cities, towns and counties for road purposes. It would mean better streets and better county roads. Better streets and roads would reduce the maintenance cost on cars. This saving would more than offset the increase in license fees.

Previous to 1923 a great many free licenses were issued by the Secretary of State. To correct this evil a bill was introduced and somebody influenced the Legislature to place a license fee upon all cars and trucks, whether municipally owned and operated or otherwise, and that fee goes to the State Highway fund; consequently the cities are paying license fees on their city street trucks and other cars and the money is being expended outside of the corporate limits.

I have no quarrel, however, with the State Highway Department. They are doing good work and must be encouraged. I am told that in 1923 $2,475,000 was appropriated for State Highway projects, while in 1924 it amounted to only $1,425,000 available for highway work

and that this reduction will seriously handicap them.

The gasoline tax is the most equitable and just of all special taxes or fees. It places a part of the burden of maintaining streets and roads directly upon those who are using them and wearing them out and this in proportion to the weight of the car or load and the number of miles traveled.

In addition to the 2 cents tax now collected by the state, 1 cent a gallon should be collected for the benefit of the incorporated towns and cities. With such a tax the thousands of visiting cars using our streets would be contributing to the expense, as they all purchase gasoline. The heavy transportation trucks operating along state highways and roads would also be paying their proportion of the wear and tear in use of the streets. This tax could and should be collected by the state, as the present gasoline tax is now collected. It would entail no additional expense for collection and the percentage due the cities and towns could be remitted by the state treasurer.

Unless one or both of these plans are given consideration some method should be found whereby cities and towns can legally levy and collect a gasoline or automobile tax. As I have before stated, the gasoline tax is the more equitable. The application of such a law would not be difficult. For example, in Colorado Springs all gasoline dealers are now licensed. A failure to collect and pay such a tax could be made cause for the cancellation of the license.

Referring to the county road fund—there is such a difference in valuations that I can not determine where in some counties the cities would be benefited. For example, the valuation of El Paso County is about $70,000,000 and the valuation of Colorado Springs, the principal city in the county, is about $40,000,000. If any per cent of the county road levy were devoted to city or town uses the county commissioners would of necessity increase the levy and there would be no benefit either to cities or towns or the county. This would work out differently in counties where the valuation was greatly in excess of all cities and towns, as in such counties a small proportion of the road levy would be of benefit to the cities and towns and the percentage of the levy diverted so small that the counties would hardly miss it. Without more information I could not say more or endorse the plan suggested.

In conclusion, I am convinced that no portion of the tax and fees now going to the State Highway Department should be diverted. We want good highways; we want our cities and towns linked together with good roads, and if the highway department is to operate successfully not only the present income is needed but any additional increases from the same sources.

This organization (Colorado Municipal League) should endorse a movement to increase the gasoline tax, allowing the increase to go to the cities and incorporated towns. If that does not meet with your approval, you should then endorse an increase in the automobile license tax.

I feel that it would be very much easier to put through one measure than to attempt to pass two or more. It will be necessary to centralize on one and get behind it unanimously.

PAVING BRICK SHIPMENTS

Catching up on an unusually late season, shipments of vitrified paving brick for the month of June showed an increase of more than three million over the month of May with a consequent falling off of stock on hand and a slight reduction of unfilled orders, according to the monthly report of the National Paving Brick Manufacturers' Association is sued for the United States Department of Commerce. The report covers 23 companies representing only 62 per cent of the tonnage of the industry.

Production for June was 24,998,000 as against 26,569,000 for May. Shipments for June were 27,786,000 as against 24,507,000 for May. Stock on hand the last day of June was 111,637,000 as against 122,303,000 for May. Unfilled orders the last day of June totalled 99,314,000 as against 100,242,000 for May.

Out of the total distribution for June, 20,501,000 went for city streets and 4,011,000 for country highways, the balance being unclassified. Of unfilled orders, 65,123,000 are for city streets and 30,102,000 for country highways, the balance being unclassified. In June, Ohio led all other states in consumption, taking 2,229,000 for city streets and 3,389,000 for country highways. Kansas was second with a total of 3,108,000 and Pennsylvania third with 2,798,000.

PROCEDURE IN PAVING DEPARTMENTS OF VARIOUS CITIES

(Editor's Note: The Engineers' Club of Philadelphia has, on more than one occasion, reminded us of the continuing great importance of city street paving in this era of intercity highway construction. The Club held a conference on the administration of city paving departments early this year, and some of the reports presented at that conference were published in "Engineers and Engineering" for July, 1924. This matter is here reproduced to give it wider distribution.)

Philadelphia

Mr. J. H. Neeson, Chief of the Philadelphia Bureau of Highways, reported Philadelphia conditions as follows:

In Philadelphia, the highway organization, while it is not complicated, is divided into two functions—one of highways and one of street cleaning. It is the largest metropolitan city that has an organization of this character. This came about, originally, owing to the fact that street cleaning and the collection and disposal of waste has been considered by engineers to be a function of street maintenance. Whether it is or not is a very debatable question. With proper control there would probably be little difficulty in handling it. As a part of a big system, as it has been in Philadelphia up to two or tnree years ago, it simply meant supervision, the supervision being supplied by the highway engineers and the inspectors under them, their only duty being to see that specifications were carried out in accordance with contract. But when you turn from contract work to municipal work it becomes a different proposition, because then you are directly handling an organization of your own, involving several thousand men—in the case of Philadelphia, three thousand.

Considered from that standpoint, a division of street cleaning may become unwieldy and unmanageable, and, in connection with the functioning of the highway department, there may be ground for contention as to whether it should properly be included.

There are, however, other reasons why, from an engineering standpoint, we should consider street cleaning as a function of highways. There are certain related costs, certain related engineering reasons, why street cleaning should be considered a part of the maintenance of highways, but it is a question of such magnitude that it resolves itself down to one of policy, and for that reason I will dismiss it without any further comment.

The highway unit has charge of the construction and maintenance of all city street paving and country roads; of boulevards and parkways; the maintenance of bridges, sewers and water courses; the supervision of all matters affecting the use of public highways between building lines and such incidental work as erection of buildings and development of city property areas, as may be directed by special legislation.

The street cleaning unit now has direct charge of the operation of cleaning streets, including the removal of snow; the collection and disposal of ashes, rubbish and garbage by municipal forces; the construction and maintenance of buildings (stables, reduction and incinerator plants, garages and shops), plant and equipment.

The control of the combined units is vested in the Chief of the Bureau of Highways.

The personnel of the Highways Division consists of 700 to 800 employes, comprising Engineers of Construction and Maintenance; Division and District Engineers, assistant engineers, inspectors; street, road, bridge and sewer maintenance units, and the accounting and clerical forces. The Street Cleaning Division has on its rolls 2,800 to 3,000 persons—assistant and supervising engineers, district superintendents, veterinarians, superintendents of plant and equipment, inspectors, accountants, timekeepers and clerks, and the force necessary for the daily collection and disposal of ashes, rubbish and garbage and the cleaning of streets.

Each division is in direct charge of a Deputy Chief.

The Highway Division is responsible for maintaining and keeping in good repair over 1,600 miles of improved street and road pavements, 1,100 miles of sewers and 275 bridge structures; constructs new streets and roads (including grading and paving); repaves and resurfaces; constructs boulevards and parks; executes 500 contracts annually and has control of the expenditure of approximately $7,500,000 of current and loan funds. The Street Cleaning Division cleans, on definite schedules, the above mileage of streets and roads; serves 2,000,000 people in the collection and disposal of waste; operates a garbage reduction plant; con-

structs new plant and equipment; provides for upkeep of garages, stables and shops; maintains 1,800 horses, 800 pieces of horse-drawn equipment and 125 pieces of motorized equipment, at a total annual outlay of current and loan funds of approximately $5,500,000.

The combined cash expenditures of the Highways and Street Cleaning Division range from $13,000,000 to $15,000,000 annually.

The organization of the Highway Division for construction and maintenance of streets and roads has been thus established for several years. It has never been found necessary to modify the method of its functioning, except for slight changes in procedure, since originally designed for strictly highway purposes. It is fundamentally sound in conception, being built to fit the geographical conditions of the city as well as to supply the proper amount of engineering supervision and control. It is sufficiently flexible to permit of such expansion as would be necessary to take care of a comprehensive program of construction work—mainly additional engineering and inspection service.

Construction practices, being standardized, are carried on in the subdivisions or districts under the direction of the Engineer of Construction, a similar procedure being followed on maintenance work of streets and roads under the Engineer of Maintenance, both of whom report direct to the Chief Engineer. The organization functions in such a manner that the Chief of the Bureau may engage himself with important administrative details while exercising control of the entire organization through his principal subordinates.

There has been a slight modification since its original conception, in that when the Highway Bureau was first organized on an engineering basis, 12 years ago, the functions of construction and maintenance were equally divided between two division engineers, the division engineers having charge of an allotted number of districts—the work being approximately equally divided between the two.

Changes made a few years later, probably six years ago, resulted in a modification of the organization to the extent of putting one engineer exclusively in charge of construction work over the entire city, and an engineer in charge of the maintenance work over the entire city. That is the principal change that has been made, but it also has resulted in a number of modifications and changes from the original, which are more or less automatic. By dividing the work between two division engineers their various functions could be properly co-ordinated, but when that work was taken away and an engineer of construction and an engineer of maintenance instituted it upset, to some extent, the original plan, and we haven't been operating under that latter plan for about six years. From an organization standpoint and engineering standpoint, in my mind, the original plan was the better of the two; but we haven't reached the point yet where we are quite ready to return to it.

Our general outside work—our highway work, rather—is placed in charge of six district engineers, whose duties are to assume charge of the construction of new streets and roads and the maintenance of streets and roads. Under them are the various inspectors of construction and of maintenance. Each district engineering force acts as an individual unit, all coming directly under the deputy chief of the bureau, theoretically, and operating from the main office in their general work.

The question of organization of a highway department, considered simply as a highway department, is one that we would wish to standardize; that is, so far as the work of this particular organization in every city—large city, at least—in the United States is concerned. But the difficulties about that arise from the fact that by legislation, and sometimes by executive enactment, we find that functions which, as engineers, we believe should come under the highway organization, are given over to other bureaus. To cite one instance, the designing of streets and roads is allotted to another bureau, of one department.

Undoubtedly, the desirable thing to have is to combine all of the functions entering into the construction of a street or of a road, in one organization. Design should originate in the highway organization and construction be carried out by it; and maintenance should be, as it is, of course, in all organizations, an essential part of it. The ideal highway organization is the one that carries the responsibility for design, construction and maintenance; and the authority thereafter over all portions of the street, from house line to house line. There is a considerable lost motion involved

in the placing of one important function under one bureau and two others equally important under another. They should all be combined and carried out as a part of one integral unit.

The maintenance of city pavements is comparable in responsibility to the construction; the highway department should control the street from its original construction until its limit of life has been reached.

The methods in Philadelphia for locating repair work are practically the same as they are in other cities. It is a function of the district forces, through their inspectors, and the district engineers, so to supervise their work, or investigate their work and investigate their conditions that repairs will naturally show or assert themselves at once. The great difficulty is in keeping up with the actual amount of work that is to be done.

In other words, our program—and I take it it is pretty universally true—is never caught up. So that, while the theoretical organization for conducting maintenance may be sound and would work out properly, it is restricted and limited to the actual conditions under which it has to work—labor conditions, material conditions, funds available and so forth. So that, while the maintenance of streets is, from the public standpoint, more important than the actual construction, it is very difficult to keep them in such condition that the public will be thoroughly protected and thoroughly satisfied.

New York City—Borough of Manhattan

Mr. C. M. Pinckney, chief engineer of the Borough of Manhattan, presented the following statement:

The Bureau of Engineering is responsible to the Commissioner of Public Works for the construction and maintenance of all streets, street pavements, roads, highways, tunnels, stairway streets, sewers and sewer appurtenances in the Borough of Manhattan, New York City, except those within limits of public parks.

The bureau is divided into four divisions; i. e., Inspection, Design, Construction and Maintenance. The executive head of the bureau is the chief engineer, who has a chief clerk and a testing laboratory reporting directly to him. Each of the four divisions has an assistant engineer in charge.

The Inspection Division maintains a patrol system of the streets and furnishes a complete detailed report of the condition of every street in the city, including pavements, sidewalks, drainage, cuts, and all other matters for which the bureau is responsible. In other words, the Division of Inspection is the "eyes" of the bureau. All permits for the opening of pavement, and occupation thereof by builders, also for vault space, are issued by this division upon information furnished by its patrol section.

The Design Division is the creative branch of the bureau. It is engaged in the making of the city plan and changes thereto; the drainage system of the Borough, and prepares all contract plans and specifications for sewers, paving and repaving work, sidewalks, viaducts, etc., and plant and equipment of all kinds for use of the bureau.

The Construction Division executes the contract work designed by the Design Division.

The Maintenance Division repairs pavements and sewers, cleans sewers and basins, restores all cuts or disturbances in street pavements, supervises the making of sewer connections, and has the general care of all public work for which the bureau is responsible. The labor work in this division is done by skilled asphalt workers, mechanics, sewer cleaners, bricklayers, etc.

The asphalt pavements in the Borough of Manhattan are laid with a five-year guarantee, and from the date of their final completion and acceptance are under the charge of the Maintenance Division. At the expiration of the guarantee period the maintenance is assumed by departmental forces, and the material required is furnished by our own asphalt plant, which has a capacity of 4,000 yds. a day. This asphalt plant supplies material for 17 asphalt gangs, and during the months of June, July, August, September and October, four of these gangs are assigned to resurfacing asphalt pavements by the use of the heater method.

All granite pavements are laid with a one-year guarantee, and at the expiration of the one year, the maintenance is taken over by the departmental forces, and repairs are effected by 17 granite gangs, who also repair the wood block pavements in the borough.

The sewer maintenance forces are divided into three groups; i. e., basin cleaning, sewer cleaning and sewer repair gangs. Some of the basin cleaning is done by machine, and some by hand.

The foundations of pavements are re-

paired by regularly organized concrete gangs.

The engineer in charge of the Maintenance Division has reporting to him, the superintendent of the asphalt plant, all general foremen in charge of a number of street gangs, the chief inspector representing the sewer activity, and the chief inspector representing the highway activity.

The testing laboratory is in charge of a chemist, and it is the function of that section to conduct all physical as well as chemical tests on all materials entering into the construction and maintenance of all public works under the care of the bureau. A representative of the laboratory is stationed at every place of manufacture, such as wood block treatment plants, asphalt plants and cement works, etc.

Baltimore, Md.

Mr. George Cobb presented the following statement with reference to Baltimore:

In Baltimore there are three paving departments which function independently and at the same time co-operate rather closely. The first of these is the Paving Commission, created by act of the Maryland Legislature. It supervises the laying of new streets in the city. The second, the Maryland State Roads Commission, is authorized to expend from its yearly road allotment funds, 20 per cent on the paving of new streets in the city proper. The third, the Baltimore Highways Engineer Department, is responsible for the maintenance of all streets within the city limits. In each contract let under the Paving Commission, a clause provides that final acceptance of the work will not be made by the commission until an inspection is made after an interval of six months, provided the expiration of the six months' period falls between May 1 and December 1. Otherwise the final inspection will be made immediately after May 1, succeeding the completion of the work. Upon acceptance of the work, the Paving Commission then places it in the hands of the Highways Engineer for future maintenance. In the case of the Maryland State Roads Commission, work completed under their supervision is immediately given a final inspection and then turned over to the Highways Engineer.

The Paving Commission operates under its chairman, who is also consulting engineer to the commission—Col. R. Keith Compton. His principal assistant is an associate civil engineer, under whom a corps of assistant engineers supervise the contracts allotted to their several districts. Under each of these assistant engineers are inspectors and aides, who remain constantly on the sections of work in active operation. The drafting room personnel, under an office engineer, reports directly to the chairman and consulting engineer. Likewise does the secretary to the commission report direct to the chairman. Under the secretary come the clerical forces. The commission operates a paving testing laboratory, in charge of an engineer, who also reports to the chairman direct. Under this engineer are asphalt plant inspectors—one located at the plant of each contractor in active operation—and laboratory assistants. The asphalt engineer is charged with the selection of proper materials and maintenance of correct mixtures. He makes daily trips to the operating plants and streets under construction and has analyses made of the materials and mixtures at each. The chairman maintains a system of daily reports whereby his street and plant forces render him an exact statement as to the yardage of paving laid and the total depth after compression. Once a week he holds a meeting, attended by all of his engineers.

The head of the Maryland State Roads Commission is the chairman and chief engineer, Mr. John Mackall. He has an assistant chief engineer, who has under him division engineers, one of whom is assigned to each district in the state. The division engineers have their individual forces of inspectors and assistants. They supervise their work in its entirety, with the exception of sheet asphalt. When a state contract provides for the latter material, whether the work is to be done in the City of Baltimore, out of the yearly 20 per cent allotment of state paving funds, or anywhere in the state, the Paving Commission's laboratory is asked to provide plant inspection. This arrangement, by mutual agreement of the State and Paving Commission chairman, has obtained for five years. For this service the State Commission pays at the end of the year to the Paving Commission, a sum based on the pro-rated cost per square yard of all the paving inspected by the Paving Commission's laboratory during the year. In the selection of streets to be handled by the State Roads Commission, the

commission invariably follows the recommendation of the Paving Commission. The Paving Commission then lists these streets and acts as the intermediary between the State Roads Commission, city departments and public service corporations. When the utiliies are completed, the release comes through the Paving Commission to the State Roads Commission, thus insuring close co-operation between the city and state.

The highways engineer, Mr. Bernard L. Crozier, is in charge of the Highways Engineer Department. He has an assistant highways engineer, who is directly over the superintendent of sheet asphalt repairs. This superintendent is in active charge of the paving inspection force. He assigns inspectors to the several paving zones, into which the city has been divided. The zone inspector is held responsible for the proper laying of necessary repair work in his zone. A second assistant engineer, reporting to the assistant highways engineer, is in charge of surface treatment work in the suburban areas. He directs his force of inspectors. As in the case of the State Roads Commission, the highways engineer calls upon the Paving Commission's laboratory for plant inspection and in a similar manner, pays for the service.

Because of close co-operation, paving inspection costs are reduced to a minimum, each of the three paving departments benefiting proportionately. As an index to the efficiency of this system, it might be noted that in 1923 the amount of repair work relaid on bituminous streets in Baltimore, due to defective and worn out paving, was 1 per cent. The paving involved covers 4,500,000 sq. yds., the oldest of which was laid in 1898.

Indianapolis, Ind.

Mr. John L. Elliott, as city civil engineer, presented the following statement on Indianapolis conditions:

All street paving and maintenance is under the direction of the Board of Public Works, but under the direct supervision of the city civil engineer. The City Engineer Department prepares the necessary plans, specifications and resolutions for street paving, which are submitted to the Board of Public Works for hearing and contracts.

All construction work on new paving is done by contract under the direct supervision of the Inspection Department which is a part of the City Engineering Department. The City of Indianapolis maintains its own maintenance department under the direction of the city civil engineer, which repairs and maintains all improved streets.

The maintenance department is under the general superintendent, two assistant superintendents and necessary foremen, which are under the direct supervision of the city engineer. During the summer months, the city maintained two asphalt repair gangs, one emergency gang, two wood block and brick repair gangs and one sidewalk and curb repair gang, each under a foreman experienced in the handling of the particular class of repairs.

The larger repair gangs cover the city from the repair yard to the city limits by gradual stages, making permanent repairs as they go. The emergency repair gang is used for emergency repairs which will not be reached by the repair gangs for a considerable length of time. The necessity for repairs is brought to the attention of the department by the Police Department and the Inspection Department. These requests are noted and necessary repairs scheduled by the repair department.

The city maintains an asphalt plant approximately 1,200 yds. capacity with which all asphalt repairs are made. The brick and block repairs, to a great extent, are made by replacing worn brick and block with new construction. If the condition of the street is such that this replacement would cost more money than justifiable, the street is then either resurfaced or patched with asphalt until resurfacing is accomplished.

STANDARDIZATION OF AUTO TOURIST CAMPS

By Harry N. Burhans, Denver Tourist Bureau, Denver, Colo.

The automobile has stimulated tourist travel to the extent that it has become an important industry in the western states, and the method of providing facilities and accommodations in the auto tourist camps has become an exceedingly important problem. It is estimated that travelers expended $45,500,000 in Colorado last year.

The number of tourist camps has increased in Colorado from two camps in 1915, with 4,500 campers, to 247 camps, with 643,000 campers, in 1923. Visitors to Rocky Mountain National Park increased from 31,000 in 1915 to 218,000 in

1923. Perhaps 80 per cent of our auto camps are lacking in facilities essential for the comfort and convenience of the traveling public. These camps may be compared, for purposes of illustration, with the 20 cent per night rooming houses on Larimer Street in Denver. As long as many of our camps remain in their present condition we can cater only to the class of trade which patronize the cheap rooming houses. The better class of tourists will not patronize these free camps, and in the absence of better equipped camps, they will be driven away from Colorado.

The Free Camp

The free auto camp has encouraged the man with only a few dollars in pocket to travel because he can get everything free. This class of tourist is a hindrance, rather than an asset to the state. The itinerant traveler which free auto camps has developed has become a menace to the country. He has nothing to contribute to the upbuilding of the country except his labor, the labor market is soon glutted, and when this happens he becomes a public charge on the community. Not only so, but the large influx of this class tends to drive away the more desirable classes of tourists. The community which endeavors to cater to this class of tourist by maintaining a free auto camp is pursuing an unsound policy. The advertising value and trade value of a tourist camp which caters to this class is negligible.

In July and August our camp grounds are taxed to their capacity, and the questionable characters who loaf their way across the country in broken-down automobiles, having no objective in view, only add grief to the many other cares of camp attendants.

An auto camp which does not provide the minimum essentials necessary for the comfort of travelers is almost sure to become a public nuisance. Lack of proper sanitary arrangements results in polluted streams, and the camp site becomes a serious health hazard to campers and residents of the community. State Boards of Health in several states, notably Florida, California and Iowa, have adopted rigid rules and regulations governing the sanitation of camps, and Colorado must soon take steps to standardize her camps for health reasons. It may be necessary also to pass state legislation governing the matter.

Colorado has a larger percentage of inferior camps today than any other western state, because for several years the small communities in the western states have been making a small service charge and have used the money for the improvement of their camp grounds. Smaller communities now have clean, attractive grounds, community houses, caretakers, and many comforts and conveniences which do not exist in Colorado camps except in the larger cities.

The Pay Camp

A study of the automobile camp situation in the western states shows that a charge of 50 cts per car per night is almost universal. Cities that still maintain free camps are advocating pay camps in nearly every instance, because these cities realize that this plan will bring the desired automobile travelers and will also make it possible to establish better camps. The charge has the effect of discouraging the undesirable element from traveling and makes it easier to maintain the morale of the camp.

A year ago 96 cities in the United States had adopted the pay camp system. California had 37 pay camps, Washington 18, Oregon 9, Montana 8, Arizona 3 and Idaho 2, and the number of cities making a charge has increased greatly during the past year.

Due to the inadequate facilities in so many of our tourist camps, Colorado is in the position of catering to the poorer classes of tourists, because we can only cater to the class of business to which the kind of facilities we have to offer appeals. If the cities of Colorado are to compete successfully with these western cities, our camps must be improved and enlarged, and the best way to accomplish this is to place them on a sound financial basis. Colorado should become known throughout the United States for its beautiful and attractive camp grounds, and this can only be accomplished by the adoption of the pay camp system. Colorado is on the eve of the greatest era of prosperity in many years, if not in its history, and the only way in which it can successfully get its house in order is for every community to do its share. Smaller communities do not get the most of the travelers' visit, particularly of the motorist, when they allot the vacant land next to the mercantile store as a camp ground and place it in charge of the grocer who sells them supplies. There are many such so-called

camps which are not deserving of the name. The motorist is deserving of the hospitality of the community, and we should pay more attention to travelers, whether they come by rail or by automobile. Every industry or business benefits from the traveler industry, because every traveler is a potential prospect of some sort. However, there is no more reason why a person who travels by auto should be provided with all the facilities free of charge than that a person who travels by rail should be given accommodations at a hotel free of charge.

The More Desirable Tourist Favors Pay Camp

Numerous investigations have been made among patrons of tourist camps to learn their attitude regarding paying an admission charge. These investigations have revealed the fact that a very large percentage of the better class of travelers prefer to pay a reasonable admission charge and be guaranteed better facilities, service and protection. Chief objections come from the hobo class, whose only home is the car they are traveling in. It may be questioned whether our cities are justified in maintaining free camps for this latter class.

The foregoing paper by Mr. Burhans was presented at the recent annual meeting of the Colorado Municipal League.

SUPERPOWER IN INDIANA

By John Ferguson, 506 Guaranty Bldg., Indianapolis, Ind.

There are many conflicting conceptions of the meaning of superpower. Most of the popular ideas of it are narrow and limited, whereas the true meaning is one of great breadth. It does not mean alone large individual prime movers—producers of power. It does not mean alone massed power capacity concentrated in large stations, serving in isolation densely populated centers. Its scope is instead state-wide and nation-wide.

Superpower Defined

Superpower may best be visualized by considering it as the capacity for delivering, in amounts relatively unlimited, supplies of electrical energy from transmission line networks of high voltage girdling the whole country; networks into which numerous power plants feed as into a pool or reservoir; power plants of impressive magnitude, plants which require the full output of mines for their fuel requirements, and are therefore built at the mine mouths, and which also take the full flow of goodly rivers for their water requirements; a combination which enables the engineer to transform the heat energy latent in the coal into electrical energy with the least possible economic loss, and making that energy available by means of the transmission line network into which it is fed, at suitable points anywhere throughout the country where the demand for power is either active or latent. Superpower has, in short, the potentiality of effecting fundamental changes in economic conditions as we know them today.

Until a very few years ago, the requirements of a community for electrical energy were met by its local central station. Some of these plants were capable of being operated economically—others were not. Some were well favored by being situated on streams from which water for condensing purposes could be drawn, but large numbers had to exhaust their steam to atmosphere. Very seldom did such plants have capacities in excess of the demands made upon them, after allowing for reserve requirements. Never did they have excess capacity in such large volumes that they were much in advance of the industrial demands. On the contrary, the central stations have lagged so far behind the gross demand for power that industries of any great size were forced generally to build isolated plants of their own to meet their needs. The result is that in all great industrial centers there is a multiplicity of power plants, the whole resulting in a vast economic waste.

The Isolated Plant

In a great many cases the isolated plant has survived on account of a presumed belief that it could produce power more cheaply than it could purchase such power from central stations. This has very frequently proved to be a fallacy. The owners of such plants seldom take into account all the charges which properly should be apportioned to the cost of power. Only when the plants begin to reach a stage bordering on obsolescence do they realize that yearly reserves should have been set aside to take care of the cost of rehabilitation and that such reserves are a necessary charge against their cost of producing power.

The Superpower Age

The age of superpower which we have

just entered is beginning rapidly to change the above conditions. The interconnecting of central stations by transmission lines introduces two great fundamental changes into the power situation. First, the central station is no longer limited to its own plant capacity in supplying power demands. It can draw on at least one, and frequently three or four other sources of supply for its district requirements. Second, as power is no longer confined to its point of origin, the towns and villages which the transmission lines pass which connect these plants acquire all the advantages which could be derived from having a large central station in their own midst. No longer will their development be retarded due to a lack of power. Superpower is as readily available to them as to the larger industrial centers, and it is highly probable that this new factor will stimulate the growth of rural centers and will introduce a new influence on economic conditions throughout the country.

The Indiana System

Such a superpower system is in being in Indiana through an amalgamation of the resources in plants and transmission lines of the Northern Indiana Power Company, the Merchants Heat and Light Company, the Wabash Valley Electric Company and the Indiana Electric Corporation. The high voltage transmission lines connecting the central stations of these companies have an aggregate length approaching 1,000 miles, and the power plants feeding into the transmission line system are located at Logansport, Rochester, Wabash, Huntington, Kokomo, Noblesville, Sheridan, Indianapolis, Greencastle, Clinton, Attica, Sullivan, Spencer, Martinsville and Terre Haute. The latter is a new plant, of the most modern type, having units of 20,000 KW capacity each. It is located on the west bank of the Wabash River, on its own coal land, and is the prototype of what most future power plants will be. Transmission lines radiate from it, north, south and east. The lines going east to Indianapolis are carried on steel towers, at a voltage of 132,000, serving an outdoor steel-structure substation of impressive size, which furnishes power to the city of Indianapolis, and from which the transmission lines at voltages of 66,000, connecting the plants of the other associated companies, radiate. The generating capacity of the plants operated by the above companies is about 100,000 kilowatts, and the number of cities and towns now served by the power system connected to them is 130.

Interconnection

In addition to meeting the requirements of the districts served by the associated companies forming their own superpower network, interconnection is also made with the transmission line systems of other utilities. Such interconnections are formed at Sullivan with the Indiana Power and Water Company, with lines as far south as Vincennes; at Martinsville with the Interstate Public Service Company, with lines extending into Kentucky; in the east at Marion, with the Indiana General Service Company's system; in the north at Plymouth with the Indiana and Michigan Electric Company's system, which has transmission lines extending into Michigan and Ohio.

Rapid Growth of Superpower

When it is considered that the conception of the vast power network above described has been brought into being within the last two years, it will be realized how rapidly superpower is receiving its application. This growth has been more rapid in Indiana, where the driving force behind it has been supplied by the genius of L. B. Andrus, chief engineer of Kelsey, Brewer & Company, than in other states. Superpower places Indiana in the most favorable position for receiving the benefits of industrial expansion, and it operates so much to the general welfare of the State that the companies associated in the development should receive the goodwill of all its citizens.

Power companies in other states are working, perhaps less rapidly, along the same lines, and it is only a question of a few years till all the large central stations of the eastern and north central states are linked together with an intricate and vast transmission line network which will make available everywhere the benefits of electric energy for power. light, heat and transportation, to a degree hardly realized att he present time.

SOME PRESENT PROBLEMS IN ILLUMINATION

By C. E. Weitz, Engineering Department, National Lamp Works, Nela Park, Cleveland, Ohio.

The illuminating engineer has given us good equipment and methods for its use

in taking care of most any lighting problem that comes up in the major fields of lighting. He has established certain facts on the value of proper lighting and has recommended standards of lighting much in excess of those previously thought adequate.

Though the public in general has in many cases been slow in putting into practice many of the modern methods, this resolves itself into an educational problem or the equivalent, a sales job based on the facts which are established. The illuminating engineer, if he is rightfully to be called an engineer, must turn to new things, establish new truths, pioneer into new facts which influence his chosen field. And to best explain the new angles that are now engaging the illuminating engineer's time and attention, I want to draw freely upon an "Electrical World" editorial which appeared a few months back.

Electricity, as you know, has been a boon to mankind in many ways. It has served to produce light when and where it was wanted; it has come to perform the tasks of industry and of the household; it is used directly in manufacturing processes of various kinds; it provides warmth; it provides flexibility, and the electrical industry has been constantly at work devising new ways in which it can serve. But it was only recently that there came a realization that light, the earliest form of service by electricity, had much latent ability to be of far greater service than had previously been thought possible.

Influence of Light on Production

All early work by illuminating engineers in their attempt to provide adequate light for factories and other industrial establishments was directed toward the proper distribution of light to give virtually uniform illumination of an intensity recognized as sufficient for work to be carried on. Light in its relation to production was considered solely from the standpoint of a substitute for waning daylight. But it is characteristic of engineering development that study and analysis continued until it was definitely shown that the amount or degree of illumination was a vital factor in increasing production in all kinds of work. No longer was it a question of determining whether the light satisfied the average investigator or the average workman as being enough to enable him to "see his work all right." Rather were definite data gathered to show that as intensity increased, so did production.

As a specific example, in tests recently conducted at the Columbus plant of the Timken Roller Bearing Co., the employes were not consulted and their reaction to the various levels of illumination provided showed up in the daily production record. There was no demand for better lighting on their part but the higher standards of the order of 15 to 20 foot-candles were provided for the test purely in an effort to establish what relationship, if any, exists between illumination and production. The test data showed that the curve for production during any period followed closely the curve of the illumination intensity increasing as the illumination was increased and falling off when the illumination was lowered.

The engineer does not yet know to what intensity it is desirable to go. It is known that on changing from 3 to 4 foot-candles to 15 or 20 or 30 foot-candles there is a definite increase in productivity. Some experiments indicate that 50 foot-candles is not too high, and some able and experienced engineers talk in hundreds.

Enough, however, is now known on the subject to cause many manufacturing executives to realize that illumination does play a real part in the productive effectiveness of their plants. They can see that by increasing the expenditure for light by three, or four, or six times, they have to increase only one of the very small elements of their manufacturing costs and that the returns on this expenditure is manyfold. Thus in the case of the Timken plant previously referred to, it was shown that when 20 foot-candles were provided, the increased cost of lighting over the original 5 foot-candle lighting system amounted to to about 28 cts. per hour, the 12½ per cent increase in production obtained meant a saving of $1.44 per hour in labor.

From the standpoint of the illuminating engineer the problem of lighting thus presents many new aspects. He is no longer merely a calculator of illumination intensities. He has to consider his contribution to the producing ability of the plant, and the actual illumination studies he makes are complicated by the intrusion of glare and similar problems on account of the intensities used. Requirement and opportunity exist for a great deal of illuminating engineering ability in the successful application of

this newly-developed philosophy of industrial illumination. Only a small part of industry has so far reaped the benefits, but from now on surely no engineer charged with the layout of a factory, and no engineer charged with the problem of lighting it, can fail to consider fully the relation of illumination to that factory's production.

What I have just said follows closely the "Electrical World" editorial. This seems to state the current problems in lighting for the industrial field and the same idea might well be carried over into the other two main fields, the commercial and residential. From the standpoint of the illuminating engineer, the present-day problem of illumination has taken a new turn, an upswing on a new cycle of progress.

Improvements in Lamps

Through all the ages, little progress was made in the science of lighting, its history being merely a record of various illuminants from olive oil to kerosene. There was need for more light and the electrical business got away successfully because the lamps gave a stronger light. There was a time when the big thing in electric lighting was the light source itself, when progress in lighting was reported entirely by new developments in lamps and lamp efficiency. But this period halted about 1913 with tne advent of the gas-filled Mazda C lamp because since that time no new or revolutionary light sources have appeared above the horizon. The carbon lamp with its many improvements, the Gem, the tantalum, the pressed tungsten, the drawn wire filament Mazda lamp and, finally, the gas-filled lamp, are fairly definite stages in the development of the incandescent lamp. The result is that the lamp is good.

Then lighting engineers began to think about the best application of the incandescent lamp. With the introduction of these gas-filled lamps it became apparent that we had suddenly broadened our knowledge of light sources far beyond any commercial appreciation of them. Even though our stores and factories were demanding more light, the substitution of these high-powered lamps for previous types, instead of bettering visual conditions, actually hindered and made vision more difficult. The past 10 years have given us equipment which embodies 10 years of engineering effort with metal, and glass, and physics of light as ingredients to change raw light into good illumination. Their studies during that time have been qualitative. They have turned their attention from the lamps to the service they render with the result that a cross-section of illumination shows that there are a number of factors, such as glare, reflected glare, shadows, color quality, as well as the actual amount of light, enter into the question of proper illumination. We have endeavored in this demonstration to show how these various factors enter into the question of good lighting.

Prescribed Lighting

We know enough about lighting fundamentals now to analyze the requirements of any operation and to prescribe lighting which will be satisfactory and illuminating engineers have so simplified this task that it is no longer a problem for the engineer, but, in the majority of cases, can be solved by the least experienced. What used to be a tedious, all-day task in computing illumination results has become a matter of a few minutes' reference to standard data.

Certain standards of illumination have been specified for various classes of service and just now illuminating engineers are asking themselves, "Are these present standards efficient?" The answer to this question involves many things. It involves the theories of vision, physical and psychological reactions to light, and many other things of a scientific nature. These studies have carried far beyond the material things, beyond the lamp and the reflector, to a study of human reactions to light under various circumstances.

So today we talk of illumination in its relation to production, to the health and welfare of the workers, which factors are so intimately tied in with industrial operation; we refer to store lighting or show window lighting, not in terms of lamps, reflectors, wire or sockets, essentially, but in terms of its sales-producing value to the merchant or its attracting power in compelling attention to merchandise, which are prime functions of commercial establishments. In homes, we are applying light not merely as a substitute for daylight, but, in addition to pure utilitarian needs, as an agency to promote comfort, convenience, and decoration—to improve the home esthetically—or, as a definite example, light has made a basement out of a potato cellar.

Relation Between Lighting and Health and Efficiency of Workers

As an example of this new philosophy of light, let me cite a few practical instances. The United States Post Office Department is in the process of relighting the post offices all over the country. Did they undertake this because of late revolutionary developments of lamps or new illuminants? Did some manufacturer of lighting equipment sell them the idea by virtue of some new type of reflector that was claimed to double the efficiency of the lighting system at half the cost? Not at all. Lamps and reflectors were a secondary consideration. This department is the largest of all government agencies in point of personnel and has a real problem of maintaining the health and efficiency of its employes. Their studies and decisions were based on special governmental investigations: (1) That employes of a post office working under 2 or 3 foot-candles had less normal vision and more eye defects than employes in another office working under 3 or 4 foot-candles, and (2) in speed and accuracy tests, letter separators increased their speed 4.4 per cent when the illumination was raised from 3.6 to 8 foot-candles.

What Improved Illumination Accomplishes

Within the last few years we have read reports of dozens of tests which show the relation of illumination to production, to accidents, to industrial spoilage, to sales in stores, etc. A few months ago we read in "Factory" magazine an article by Mr. Magee, president of the Detroit Piston Ring Co., entitled, "How Better Illumination Increased Our Production 25 Per Cent." A paper before the Illuminating Engineering Society at their September (1923) convention showed that in the inspection department of the Timken Roller Bearing Co., a 12½ per cent gain in production was obtained with increased illumination at an increase in cost amounting only to 2½ per cent of the payroll. A recent test in a Chicago department store showed that when their lighting system was alternated to produce 5 to 15 foot-candles that sales fluctuated likewise and the net result after several weeks' test showed a 29 per cent increase in store sales in favor of modern lighting. Many more such cases could be cited. However, I did not set out to convince you of the value of good lighting but merely wanted to show that the thought on lighting had gone beyond the material things which make up a lighting system —the lamps, wire, switches and reflectors, and methods which are already good—to a more complete understanding of the good that proper illumination will do.

I would sum it all up by saying that at present the lighting engineer's job, in the three major fields, is the dissemination of his knowledge to the public in a way which will be effective in narrowing the spread between lighting conditions common today and what they would be if advantage were taken of the most effective use of our electric lighting service.

There are several hundred thousand plants in the United States and it is estimated that less than 40 per cent have what might be called good lighting. There are about one and one-half million stores in the United States and it is fairly definitely established that only about 30 per cent of these have good lighting. In home lighting, although we know that, conservatively speaking, the average home might well double its average kilowatt consumption to get the greatest yield on its electric lighting service the possibilities of light as a decorative medium are so unlimited that it is difficult to predict the market in this field.

We have good lamps, we have good reflecting equipment, we can produce good illumination, and illuminating engineering has turned from these things which formerly occupied all their time, to engineering facts which outline the limits of progress with materials at hand.

There is a wide divergence between principle and practice in lighting and the business of making these two coincide is largely educational and commercial. Lighting always has been the backbone of the electrical industry. It has been the impelling motive in the introduction of electrical service into every community that now enjoys it. In view of the new thoughts on lighting we have a market that is capable of expanding in two dimensions. No longer need the central station, the electrical jobber, contractor or dealer look solely to virgin fields for more business, but there is a tremendous market for better lighting all around him among his present customers.

Lighting comprises 25 per cent of the Central Station's load and returns about

60 per cent of the revenue. It makes up 66 per cent of the jobber's sales and 68 per cent of the dealer's sales; and there is an opportunity to double the present volume, if properly promoted.

The Lighting Business

The lighting business—the job of merchandising illumination — is different from the merchandising of most other commodities because light itself is so intangible. There is little romance or pride of possession in the materials—the wire, switches, sockets, or lamps which make up a lighting system—consequently lighting sales must be made primarily on a basis of better visual conditions, which, perhaps, the prospect has never experienced or, at least, has never definitely associated as a definite lighting aid. In selling automobiles, tractors, electric fans or flatirons, though an appeal must be made on the basis of pride of possession, service, comfort or convenience, the sales points are usually as obvious to the prospect as to the salesman.

Illumination, on the other hand, is more subtle in its effects, and unlike an automobile engine which develops a knock or refuses to run when something is amiss and thus directs attention immediately to its troubles, a lighting system with many faults and shortcomings manifests no such obvious symptoms, and will be retained in service without alteration simply because the public has not yet come to comprehend illumination either quantitatively or qualitatively. In general, they have learned to demand only the simplest requirements and to apply illumination only for the most elementary uses.

The development of the lighting business is largely in the hands of the central stations, engineers, and educators who are in a position to go out and apply our advanced knowledge of lighting in a practical way in their own communities.

These things are getting under way gradually and in the past year at least one hundred central stations in this country made drives to improve the lighting in the stores and homes in their community. At least 250,000 kitchens have been relighted the past year, scrapping antiquated fixtures, substituting white opal glass ceiling units with 100 or 150-watt lamps. And it is estimated that there will be a million more relighted the current year. Similarly, campaigns are in progress for relighting other rooms, the laundry, the basement, etc., stores and show windows. And by the way, it is quite profitable for the electrical industry as well as appreciated service to the customer.

One central station which relighted over 3,500 kitchens of their 31,000 residential customers in 30 days' time, has shown that adding just one 100-watt lamp in the kitchen adds about 100 Kwh. load per residence customer per annum serving that customer. The added revenue without increased investment meter reading, or monthly billing greatly increases the profit from serving that customer. Selling kitchen lighting units may seem rather commercial, but it is one way to get the idea of proper lighting across. Let the housewife experience good light obtained by means of good lighting units properly placed with the privilege of going back to her old lighting after a fair trial; the proportion who would do so is negligible.

Improving the Lighting of a Truck Plant

The same is true of both the commercial and industrial lighting fields. I want to tell you about an installation in an industrial plant by way of illustration of what has been said of the newer standards of illumination. The White Motor Company is in the process of relighting their entire 52-acre plant. The old system was not really bad, in fact by many factory executives would have been considered a fair system. Now the things which influenced the directors to change their lighting were things that had to do with building quality into their trucks. Manufacturers are always on the alert to improve their product so the customer may have a better machine at a lower maintenance cost. The question of lighting came up when they found the workers calling on the stock room for local lighting units. This was during a period a couple of years ago when they weren't simply signing purchase orders and forgetting about it. They started to investigate. They wondered why, if the men had gotten along for a number of years with this same system of lighting, what it was that prompted this influx of requests for additional lighting. They found that their engineering department had gradually been narrowing down the engineering tolerances on parts and the men were being asked to work to closer limits. As these quality specifications reached the various departments, one by one, soon after would come a bunch of requests for supplementary lighting from the men at the machines, so they could

maintain their old production at the new accuracy required.

So the White Company decided that repainting might help some so they repainted the entire factory with a white paint. Then they called in engineers from the Illuminating Company and our own engineers and went over the problem of relighting. The result was that they are now installing 200-watt Mazda lamps in the New Standard Glassteel Diffuser units on 10 ft. centers, which will give them illumination free from glare, of excellent color quality, uniform, and of an amount which in the light of our present knowledge seems adequate for their needs—approximately 12 foot-candles.

But the White Company profiting by their experiences in the past have provided adequate wiring to allow the substitution of lamps to give double their present intensity, or 20 to 25 foot-candles, should it happen that again in the future their visual demands and working limits require still higher standards.

There are, of course, many lighting appications that are not so far advanced and illuminating engineers are still concerned primarily with the design of equipment and a study of methods which will serve satisfactorily.

Lighting and Aviation

Take the lighting of airplanes and aviation fields for night flying, for example. This new application of lighting has made it possible to establish a 28-hour mail service between New York and San Francisco, recently inaugurated. This service necessitated a lighted flying course over 800 miles between Cheyenne, Wyoming, and Chicago. This is a new problem of lighting still in the developmental stage, as it were, because undoubtedly the present scheme will give way to better methods. Still and all it is satisfactory for the present. This lighted strip or silver trail for the night air mail, consists of five terminal stations and 35 emergency landing fields about 25 miles apart. The terminals are lighted by giant 600,000,000 candle power floodlights visible to the pilot for a hundred miles or more; the emergency fields by 5,000,000 candlepower beams on 53 ft. towers. Then dotting the intervening distances are 250 small flashing beacons placed every three miles to help the pilot over the true course.

The foregoing is from a paper by Mr. Weitz before the 1924 meeting of the Illinois Society of Engineers.

COMPARATIVE COST OF MAINTAINING DIRT, GRAVEL AND CONCRETE ROADS

By W. F. Rosenwald, Maintenance Engineer, Minnesota State Highway Department, St. Paul, Minn.

Comparative costs of maintenance of various types of roads are actually meaningless, at the present time, because as yet we have not been able to find a unit of comparison, or of measure, in which it is possible to express such comparative costs with any degree of practicability.

It is of course universally understood that the cost of maintenance is affected by varying volume and weight of traffic, and that first thought is naturally that the "per ton mile" is a suitable unit of measure. On going further, however, you begin to discover that this is not such a natural unit as at first appeared.

Why the Ton-Mile Unit is Unsatisfactory

For instance, it has been found in the various tests, which have been carried on by the Highway Department of Illinois, the Bureau of Public Roads, and others, that traffic consisting of Ford automobiles can evidently be carried on an ordinary concrete pavement in unlimited volume and for an unlimited time with na appreciable effect on the slab. Under such traffic the ton-mile capacity of a concrete pavement is practically unlimited, so far as effects from such traffic are concerned, with corresponding absence of maintenance costs due to traffic.

If however, the traffic consists of heavy loads such as are usually common to the larger trucks, it is found that the ton-mile capacity of the same pavement is very much less; in fact, that it may be decidedly limited under this kind of traffic, and naturally the unit maintenance costs make a corresponding jump under those conditions. It is therefore evident that, in order to make an intelligent study of maintenance costs, it is not sufficient to refer to the volume and tonnage of the traffic, but that it is necessary to consider the actual individual loadings or groups of loadings. So far as I know, there has been proposed up to this time no suitable unit or units of measure, which appears practicable. In fact, the committee on maintenance of the American Association of State Highway Officials, when encountering this problem at its last meeting, was not able to find a suitable unit and in its recommendations asked for help along that line.

Maintenance costs and traffic capacity are of course also affected by other factors, both physical and climatic, some of which may develop to be as complicated as the traffic factor, but I feel safe in saying that these factors may be considered as comparatively simple and the costs and capacity due to these factors do not vary very widely on roads of the same type, and even on roads of different types. Such items as the maintenance of the subgrade, right of way and waterways, are practically constant.

The difficulties so encountered in studying maintenance costs and traffic capacity of pavements have not been so apparent on gravel and dirt roads, simply for the reason that the traffic capacity of these roads is comparatively limited. However, the traffic capacity of gravel, and even more so of dirt, roads is greatly affected by weather and climatic conditions, which also complicates the matter.

Although we have taken traffic counts in Minnesota for a number of years at a large number of points on our Trunk Highway System, and which information so gathered has proven of great help in planning the construction program, I must confess that while frequently they explain the reason for the apparently high maintenance costs on some particular road, they have not been sufficiently detailed or extensive as a traffic survey to make possible such a detailed study as it now begins to appear will eventually be necessary. In fact the change in the character as well as in the volume of traffic in recent years has been so great that a more detailed survey in the past would probably not have been of any material value at this time. It would have shown the increase and change in traffic.

Some Figures

Although comparative cost figures are of doubtful value, we may nevertheless study the expenditures with great interest, and herewith are some of the outstanding figures, taken from the cost analysis of the maintenance expenditures of the Trunk Highway System during the past year.

The expenditures on dirt roads averaged $375.16 per mile, of which 73% was for maintenance proper, 16.1% for betterments, 5.7% for special work such as marking, etc., and 5.2% for overhead and supervision. The highest cost per mile was $1,496.45 on a road which was practically entirely reconstructed; therefore three-quarters of this figure actually represents the betterment.

The expenditures on graveled roads averaged $540.97 per mile on the older graveled roads and $538.46 per mile on the more recently constructed graveled roads. Of these amounts 83.6% was for maintenance proper, 5.2% for betterments, 6% for special work, and 5.2% for overhead and supervision. The highest cost per mile on any one graveled road was $2,745.17 practically all of which can be classed as maintenance proper in this particular case.

In the expenditures on concrete roads, we find a wide variation between those made during the first year after construction and those made on older pavements. The average per mile on first-year pavements was $360.55, whereas the average per mile on the older pavements was $169.55. The difference is found to be almost entirely for repairs found necessary on the newly constructed shoulders.

Of the expenditures on concrete pavements 9% was for maintenance of the slab proper, 64.6% for shoulder and drainage maintenance, 4% for betterments, 16.5% for special work, and 5.9% for overhead. Patches and filling cracks account for $32.40 per mile. Repairs to shoulders account for $243 per mile on the new roads and $65 per mile on the older roads. Work on structures account for $25.30 on the new roads and $13.30 on the older roads. The balance comes under special work, the largest item of which was $25.30 for snow drift prevention, and $16.20 for markers, signs and warning signals.

It may be interesting to know that of the $3,253,890.52 expended during 1923 on the Trunk Highways by the maintenance organization the State Highway Department, making an average expenditure of $465 per mile, 60.7% may be classed as for maintenance proper, 15% as for betterments, 8.7% for special work, such as marking signs, snow drift prevention, which can hardly be classified as maintenance proper, and 5.6% for overhead supervision, including the operation of the district offices and the central office. Analyzing these expenditures, we find that 74.6% went for labor of various kinds, 9.6% for material, and 15.8% for operation of equipment.

Although as explained before the "per ton-mile" is of no actual practical value as a unit in comparing maintenance costs, nevertheless an application of this unit is interesting. For instance on Trunk Highway No. 3, between Elk River and Big Lake, which is paved with concrete which, it is estimated, carried

937,000 gross tons during the past year, the cost of maintenance was $.165 per thousand ton miles (about 1/100 cent per ton mile) whereas on Trunk Highway No. 1 between Hugo and Forest Lake which is a gravel road attempting to carry traffic far beyond its capacity, and which it is estimated, carried 872,200 gross tons during the past year, the cost of maintenance was $3.15 per thousand ton miles (about 1/3 cent per ton mile).

As the estimate of the gross tonnage includes the weight of vehicles as well as the loads, it is possibly reasonable to assume that the cost per net ton transported is about again as large as the above figures.

This paper by Mr. Rosenwald was presented at the 1924 meeting of the Minnesota Suveyors' and Engineers' Society.

A GREAT PROGRAM OF PUBLIC IMPROVEMENTS AT LAKELAND, FLORIDA

(Editor's Note: Typical of the rapid development of the South is this story of the million dollar public improvement program of Lakeland, Florida, a city of 18,000 population. Mr. Charles Carroll Brown, who for many years was editor of this magazine, is City Engineer of Lakeland.)

Establishing a record equalled by few cities in the United States having populations the same as Lakeland's, the 18,000 citizens of this Florida city have just voted to bond in the sum of $1,069,000 for civic improvements. The bond issue carrying by a majority of more than six to one, will give Lakeland some of the most beautiful municipal buildings to be found anywhere in the South, and the most beautiful in Florida, leading architects declare.

Plans of the new buildings to be erected were drawn by Architect Franklin O. Adams, Jr., of Tampa, Fla., in a unique contest. The City of Lakeland announced that a contest would be held between a select number of Florida architects, the best drawings of the public buildings to be accepted and the prize money awarded in the event that the bond issue carried. The work of the Tampa architect, beautiful in every detail, was selected as the most appropriate in the contest held long before the voting of the bond issue. The drawings have been placed on exhibition and have been widely praised by visitors from all sections of the country, who state that the structure will be something absolutely new in civic buildings.

In addition to the erection of public buildings, the bond issue provides for the purchase and equipment of an athletic field for the use of the Cleveland Indians and the beautification of the shores and their creation into parks, of the nine beautiful lakes within the corporate limits of Lakeland. This ambitious program will get under way within a very short time.

The projects included in the bond issue are $300,000 for the establishment of a municipal hospital for white patients; $100,000 for the purchase of a site for a new city hall and municipal auditorium; $87,000 for the purchase of a site of 80 acres for an athletic field and for the furnishing of the necessary equipment for such a recreation center; $75,000 for the erection of a municipal library building; $25,000 for the establishment of a fire station on the North Side of Lakeland; $40,000 for the establishment of a municipal abbatoir; $25,000 for the establishment of a hospital for the exclusive use of the colored population of Lakeland; $20,000 for the erection of a suitable stockade and other buildings for the proper care of prisoners; $40,000 for the erection of a suitable combination jail and central fire station; $20,000 for the purchase and installation of a modern type of municipal incinerator; $17,000 for use in the improvement of the lake shores of certain lakes within the corporate limits of Lakeland and their creation into public parks; $15,000 for the carrying out of certain needed improvements at Roselawn cemetery; $10,000 for the construction of a public comfort station in Munn Park, the tourist center; $20,000 for the erection of a suitable fire station on the South Side of Lakeland; $275,000 for the erection of a modern city hall and municipal auditorium.

Lakeland, located in the hills of Polk County, Fla., the richest county per capita in America, and the largest citrus producing county in the world, has more than doubled its resident population since the census of 1920. Work on the various projects will start within a very short time, city officials have announced.

BITUMINOUS WORK ON INDIANA STATE HIGHWAYS

By W. K. O'Neill, District Engineer, Indiana State Highway Commission

The reconstruction of some of the Indiana state highways with bituminous surfaces has entailed the practical reconstruction of the road, including the rebuilding or lengthening of bridges and culverts, widening the roadbed and surface, the easing of curves and grades, and the resurfacing with water-bound macadam preparatory to the application of a surface treatment, or a bituminous macadam surface.

When we found that the road was wide enough to accomodate traffic, that the bridges and culverts were in good condition and of sufficient width, that the foundation and surface were standing up under heavy loads at all seasons, and that there were no prohibitive grades, we repaired the depressions and irregularities by cold mix patches and paint patches and gave it a surface treatment.

The enormous increase in traffic, and especially truck traffic, has placed upon the roads a burden so much greater than was contemplated when they were built, that the foundation is not of sufficient strength even where the surface is properly maintained. I have in mind one particular section of road in southern Indiana which has been for years a toll road. It serves a number of towns in a length of 40 miles which have no railroad or interurban facilities, and as a result all freight and passenger traffic is concentrated on this highway. It was well located and built, but in spite of maintenance had been slowly breaking down under the increased traffic. For one year we tried to maintain it as a macadam road by applying stone and dragging. We succeeded in bringing the surface back to where it was smooth and fast, but at a cost for maintenance of about $1,000 per mile per year.

During 1920 we applied a first aid treatment to the foundation. We sledged large stone into the places where the road had completely failed and then applied smaller stone and dragged. When we began our construction in 1921 we were pretty well satisfied that the foundation was heavy enough.

The work consisted of the construction of an 18-ft. water-bound macadam surface which we intended to maintain as a surface treated type. It was done entirely by our own forces under the supervision of our local superintendent. The stone was crushed at a local plant two miles from the job and was hauled by truck. We specified No. 1 stone (3½ to 2½ ins.) for the base course, and No. 2 stone (2½ to 1½ ins.) for the wearing course.

Owing to the fact that we could find no suitable detour, this work was done under traffic. This multiplied our troubles and increased the expense, besides making it very difficult to obtain the smooth surface we desired. Our experience has shown that all traffic should be kept off the road when any water-bound construction is going on. It is almost impossible to avoid irregularities in the surface if traffic is allowed to rut the large stone after it has been rolled. Small depressions, say 18 to 24 inches long, are not so serious since they are not objectionable to the occupants of a car traveling at the average speed. However the longer depressions from 6 to 10 ft. are very noticeable. Again the smaller depressions can be eliminated by paint patches and successive surface treatments, while the longer waves require a lot of careful patching to bring about a smooth surface.

The length of time that must be allowed between the completion of the wearing course and the first surface treatment depends upon a number of factors. If made of very hard, poor cementing stone, traffc will blow off the screenings in a much shorter time than if made from a compratively soft stone of a high cementing value. Light, high speed traffic will suck the screenings from between the large stone more quickly than slow moving trucks. The work I have in mind was completed in October and was surface treated the following July. It was built of a hard stone of poor cementing value and as a result it was necessary to spread screenings on the surface during the fall and winter to prevent possible raveling of the surface. We have surface treated some water-bound patches a week after they were completed.

A surface is ready for treatment when it has a pitted appearance and the sharp angles of the stone are exposed. If you cannot bring about this condition by exposure to traffic, and sweeping and cleaning the surface, the treatment had better be omitted to avoid wasting money. In any case, no matter how long the surface has been exposed to traffic, it should be gone over with a mechanical sweeper,

brooms and shovels to remove mud and other foreign material, especially along the edges of the metal.

The first treatment was applied at the rate of 0.4 gal. per sq. yd. in two courses of 0.2 gal. each. To avoid traffic interference as much as possible, one half the road surface was treated at a time. As the weather was very warm, no chips were spread on the first application in order to secure as complete an absorption of bitumen by the road surface as possible. The second application was covered with stone chips, size ¾ to ¼ in. at the rate of 12½ lbs. per sq. yd. These chips had been placed along the road in piles of about ¼ cu. yd. each. The bituminous material, which met our specification for Tar T. M., was applied by means of a pressure distributor at a temperature of 140 deg. F.

The next year this section of road was given another treatment at the rate of 0.3 gal. per sq. yd., put on in two applications. Since this was a second treatment, just enough chips were spread on the first application to absorb the excess bitumen. A common fault with some surface treatments is a too liberal use of covering material. It is always possible to add chips when the surface begins to bleed; but it is impossible to take away excess chips when the surface begins to lose its life and disintegrate.

Last year we let a contract for the construction of eight miles of bituminous macadam construction. The maintenance forces undertook to rebuild the eight miles preparatory to the construction of the wearing course. This involved extending a number of small pipe and box culverts, the construction of two slab top culverts and some short retaining walls. In addition, the bridge department rebuilt three pony trusses whose length totaled 164 ft. The roadbed was widened to 28 ft., some of it through heavy rock cuts and on high fills. Sharp curves were eased off, and irregularities in grades were eliminated by building up the low spots with heavy stone and replacing the bumps at changes of grade with vertical curves.

The first three miles of the road is hill-side location, with a maximum grade of 6½% and an average of 5%. In order to eliminate the excessive crown, (which was good practice on heavy grades with the old type of road), and to obtain the necessary super-elevation on curves; the roadbed and base course were built up as much as 3 ft. at some points.

Our specifications for the wearing course called for a width of 18 ft. and a crown of 2 ins. except on curves and grades. As we approached curves we raised the outside half of the roadway until the necessary super-elevation was obtained. Beginning with a 2 in. crown on flat or very light grades, we decreased the crown in proportion to the increase in the rate of grade until on a 5% grade we had a flat section.

The work was carried on under the supervision of our local Superintendent and an Engineer-Inspector. They directed the work of a grade foreman, a bridge foreman, a foreman in charge of the construction of the base course, and a truck foreman responsible for the delivery of stone to the contractor by our own trucks. In addition to the above, we had a light grading crew that built the earth shoulders.

Our equipment for heavy grading consisted of a Holt 10-ton "caterpillar" tractor, a 12 ft. grader, slip and wheel scrapers, road plows and necessary small tools. We also organized a rock drilling gang and rented a portable compressor and jack hammer. The stone blasted out of rock cuts was placed under the base course where it was necessary to raise the elevation of the road, or where a change of location made a heavy foundation necessary.

Our equipment for building the base course consisted of two Acme gasoline rollers, two 600-gal. water tanks mounted on Quad trucks, a road harrow, a small grader, form boards, stone rakes and other small tools. One piece of equipment, which we insisted on the foreman using, was an 18 ft. combination straight edge and template. We were trying to get a smooth surface, true and uniform as to grade and crown, and tried particularly to avoid wavy surface.

We let contracts for stone to be crushed at two plants located along the road. The work of building up the base course was expected to take between 9,000 and 10,000 cu. yds., in addition to the amount called for in the wearing course. We used from 14 to 18 trucks hauling stone to our forces and to the contractor. These trucks were under the supervision of a truck foreman, whose duty it was to give each truck a daily inspection, and to dispatch trucks from both plants to deliver stone as it was needed at the various points.

The base course was built of No. 1 stone (3½ to 2½ ins.) No. 2 stone (2½

to 1½ ins.) and screenings. We used the No. 1 size along the edges where the high crown on the old road made a heavy patch necessary. On the lighter patches and in the center of the road the smaller stone was used.

Our specifications for stone used in the top course called for the No. 1 size for coarse aggregate and size No. 3 (1½ to ¼ in.) and size No. 4 (¾ to ¼ in.) for the coarse and fine covering respectively. The large stone was spread and raked to a depth of 4 ins. for the full 18 ft., requiring 1,200 cu. yds. per mile. The covering material was hauled and dumped alongside the road in 1 yd. piles ahead of the large stone, so that our trucks were kept off the large aggregate after it was spread. The keystone was delivered at the rate of 160 cu. yds. and the fine covering at 140 cu. yds. per mile.

To avoid waves and ruts in the surface, the contractor was required to harrow the large stone thoroughly before rolling. This also served to bring the larger stone to the surface. Earth shoulders had been built to a height of 4 ins. above the top of the surface and the rolling was commenced with the outside drive wheel covering this shoulder and the metal, gradually working toward the center of the road. Any depressions which developed during the rolling were eliminated by loosening the stone and adding a small amount of new metal.

The amount of rolling needed to get the best results depends on the size and hardness of the stone. No specific rule can be given. Observation and experience are the only guide. However the rolling should be stopped before the voids are closed enough to prevent free and uniform penetration of the bituminous material.

The contractor used three 10-ton rollers. One roller was used to compact the stone, ahead of the distributors. When a sufficient length for a day's run for the distributors had been shaped up, it was brought back to assist the other two rollers which were kept continually rolling the treated top.

The bituminous material used on this work met our asphalt specification A-2. We specified an application of 2¾ gals. per sq. yd.; 2 gals. on the first application and ¾ gal. on the second. The bituminous material was applied by means of a self-propelled pressure distributor at a temperature of 340 deg. F. One half of the 18 ft. width was treated at a time.

After the first application, just enough covering was applied to prevent the roller wheels from picking up the bitumen. The surface was then rolled until the voids were completely closed and the covering material incorporated with the bitumen. In extremely warm weather it may be well to allow the bituminous material to harden slightly before rolling. When the weather is cooler the rolling must be begun immediately to ensure the closing of all voids, and obtain a solid compact surface.

The remaining voids in the surface that were not closed by the rolling were then filled by brushing chips over the surface and going over them once with the roller.

The seal coat (¾ gal. per sf. yd.) was applied as soon as this rolling was finished. Care was taken to see that all loose stone, leaves and other foreign matter were cleaned off the surface. After this coat was applied the surface was covered with No. 4 chips at the rate of 1 cu. yd. to each 75 sq. yds. of surface and thoroughly rolled.

This paper by Mr. O'Neill was presented at the 1924 Purdue Road School.

EFFECT OF STORAGE ON PROPERTIES OF CEMENT

The Effect of Storage on the Properties of Cement is the subject of a very valuable report recently issued in bulletin form by the Structural Materials Research Laboratory, Lewis Institute, Chicago, as prepared by Duc A. Abrams, Professor in Charge of Laboratory.

Tests were made in order to determine the concrete and mortar-making properties of 3 different lots of Portland cement which had been stored up to 5 years in sacks under different conditions. The cements were purchased from dealers' warehouses and stored in the Testing Laboratory, in the basement of Lewis Institute, and in a shed in the yard for 2 years. After 2 years all cements were stored in the laboratory. In general the cement was stored in lots of 800 to 1,200 lbs. in standard cotton sacks; in one group of tests two brands of paper sacks were also used; in another group the cloth sacks were covered with thin layers of hydrated lime and Portland cement. Upon receipt of the cement, and after storage for 3 months, 6 months, 1, 2 and 5 years, concrete and mortar specimens were made for tests at ages of 7 and 28 days, 6 month and 1 and 2 years.

The tests were begun Nov., 1916, and completed Nov., 1923.

The report covers compression tests of about 1,250, 6x12 in. concrete cylinders, 1,300, 2x4 in. cylinders of 1:3 standard-sand mortar, and about 500 miscellaneous tests.

Principal Conclusions

The following are principal conclusions from this investigation:

1. The average strength of the concrete (mix, 1:5 by volume, relative consistency 1.00 tested in 6x12 in. cylinders, cured in a damp condition) made from the cement as received was 1,470 lbs. per sq. in. at 7 days; 3,020 at 28 days; 4,410 at 8 mos.; 4,680 at 1 yr.; 4,910 at 2 yrs.; and 6,030 at 5 yrs. The increase in strength of concrete with age shown by these tests was approximately proportional to the logarithm of the age, which is characteristic of concrete cured in a damp place.

2. There was an appreciable loss in strength of Portland cement due to storage in small lots in sacks of all conditions covered by these tests; the loss was greatest for the cement stored in the shed, and least for that stored in the laboratory. Basement storage was almost as severe as outdoors. The loss in strength was greater for the first 3 months of storage than for later 3-month periods. For example, the 28-day tests for cement stored in shed showed a loss of about 500 lbs. per sq. in. for the first 3 months' storage and about 250 lbs. for the second 3 months. Still smaller losses were found for later 3-month periods. In general the concrete strengths for the cement stored in the shed 1 year and longer, were about 80 per cent of those for cement stored in the laboratory. The deterioration shown by these tests was probably greater than would be found in a larger lot of cement stored in sacks under similar conditions.

Tests on bin-stored cement now under way have shown an increase in concrete and mortar strength for 4 months storage particularly in the 7 and 28-day tests; beyond this time a decrease was found, but up to 1½-yr. storage the strength of the cement had not, in general, decreased below that obtained in the initial tests, which were made only a few days after grinding the cement.

3. The effect of storage of cement was found to be largely a question of the age at which concrete or mortar tests were made. The early tests showed a much greater loss in strength due to storage of cement than tests at later ages. It is of the utmost importance that the strength of the cement was not permanently reduced as shown by the early tests; cement stored in shed for 3 mo. gave an average "strength-ratio" of 73 per cent (as compared to the original strength of concrete) whn tsted at 7 days, 75 per cent at 28 days, and 84 per cent when tested at 6 mo. to 2 yr. Similar relations were found for the other conditions of storage.

4. After storage of cement in shed for 3 mo. the average strength-ratio for the ages at which tests were made was 80 per cent; after storage for 6 mo., 72 per cent; 1 yr. 60 per cent; 2 yr., 46 per cent; and 4½ yr. 45 per cent.

5. Two brands of paper cement sacks gave results which did not differ materially from cloth sacks when used for storing cement for periods up to 4½ yr.

6. A thin covering of Portland cement or hydrated lime over cement in cloth sacks showed some advantage, but not sufficient to justify the cost of this method of storage.

7. There was no essential discrepancy between the indications of the compression tests of 1-5 concrete in the form of 6 by 12-in cylinders and the tests of 1:3 standard sand-mrtar in 2x4-in. cylinders.

8. The time of setting of cement increased up to storage periods of 1 or 2 yr., and decreased for the longer periods. At the beginning of the tests the initial time of setting was about 4½ hr., after storage for 1 yr. about 7 hr.; for final time of setting the corresponding values were about 8 and 12 hr.

9. The normal consistency of cement was only slightly affected by storage up to 2 yr.

10. It appears that the deterioration of cement in storage is due to absorption of atmospheric moisture, which causes a partial hydration, which in turn, exhibits itself in the lower strength-ratios for concrete, particularly at the early ages.

11. Only a negligible quantity of lumps formed up to 1-yr. storage; these were soft and readily broken. The lumps found in the sacks after storage for 2 yr. and over were generally quite hard; in the shed-stored cements lumps amounted to as much as 30 to 75 per cent of the cement. Lumps were generally discarded before testing the cement.

Concrete and mortar tests of cement pulverized lumps from cement stored for 7 yr. showed the cement to have about 30 per cent of its normal strength and

the lumps 35 per cent of the strength of the cement; in other words the "lump cement" gave 10 per cent of the original concrete strength. For these tests the lumps were pulverized to such a fineness that all passed a 28-mesh sieve and about 45 per cent was retained on a 200 sieve. Earlier tests of broken lumps screened from cement and tested shortly after it was received at the Laboratory gave strengths in concrete about 50 per cent of that made with cement from the same sacks.

THE ENGINEER IN PUBLIC LIFE

By C. E. Grunsky, Consulting Engineer, 57 Post St., San Francisco, Calif.

(Editor's Note: The following address, made by Mr. Grunsky as president of the American Society of Civil Engineers, was delivered before the Western Society of Engineers on Jan. 21, 1924.)

When we look about to find an engineer in public life we naturally turn first to the public offices, to the commissions or boards and bureaus whose functions are concerned with, or are at least in some way related to, engineering activities. We scan the lists of public works commissioners, of highway boards, of harbor commissioners, of the valuation boards and rate-fixing commissions, and the like, but only to find that such boards and commissions are not made up of engineers and that an engineer on such a board is, in fact, almost unknown. We turn next to the administrative departments of the nation, of the state, of the counties, and of the cities and find that here, too, the professionally trained and experienced engineer is a rare exception—such, for example, as the present Governor of Nevada and our efficient world-beloved Secretary of Commerce. And then finally we scan our lists of senators and congressmen, of members of our legislatures, of our boards of supervisors and of our city councils—always with the same result. The engineer is not taking a leading part—far from it, he is conspicuous because of his absence.

Some executives in high public places there are, perhaps who like a one-time Governor of California declined to consider any engineer for appointment on the State Railroad Commission—our rate fixing board—because the engineer being well informed on the subject of rate fixing is too likely to be set in his convictions and, therefore, subject to control by prejudice. In this connection it is interesting to note what is said about public service commissions in the third report of the Federal Power Commission. The Commission says:

"It is doubtless true that public regulation has not met with full success. It has failed adequately to protect the public in some instances and adequately to protect the utility in others. There has, however, been too little honest attempt to give it a fair trial. Until there has developed a public opinion which will insist that public service commissioners be chosen because of fitness for their task rather than their political affiliations, and that they shall be as unhampered in their operations as the courts, it can not be expected that there will be continuity of policy or an intelligent solution of the perplexing problems of public utility regulation. The remedy, however, is not to discard regulation but to strengthen it."

Training Fits Him for Public Office

In pointing out that the engineer is not conspicuous in public life I do not wish to be understood as claiming that every engineer, nor even every engineer that may be suggested for some public office, would really fill the office acceptably. There are always other qualifications besides engineering training and experience that are essential and frequently quite as essential for satisfactory service as the engineer's habits of clear thinking and careful weighing of all the elements of his problems. Moreover—and this I take it is the principal reason of the dearth of engineers who have become conspicuous in public life—those engineers who possess the best all-round qualifications to take prominent places in public life have made a success in private life, and are so circumstanced that they do not wish to make the sacrifice nor to make the effort involved in giving their services to the public.

Perhaps it may be held that the reluctance of the engineer to enter public life is commendable. Why not—if considered solely from the standpoint of family obligations and responsibility to present and prospective employers along strictly professional lines, or to clients, as the case may be. But even if this be so, does not the engineering profession owe it to itself, as well as to the public, to make its fair contribution of public service? This for the benefit of mankind in the long run, and for the

immediate advantage of the community or commonwealth.

Government Needs Best Talent

There is hardly a question of importance that is presented to any local state or national government in which clear thinking and technical knowledge and experience such as the engineer commands would not greatly facilitate the solution. Turn where you will and you will find this to be true.

"What shall we do with our ships?" has, for example, been a pressing question ever since the end of the war. Sell them for what they will bring is offered as the only solution. But we want a merchant marine and we still have some 1,300 ships—though for the most part at present out of commission. Here is an economic, business question deserving the best thought of the engineer, who is accustomed to analyze his problems not alone with respect to the materials and forces that he is called upon to work with but also with respect to the financial aspect. The permanent advantage of having under control for all time an adequate merchant marine is to be weighed against the cost of retaining ownership.

Of operation, we are told, that the United States has had its fill. Our Shipping Board has found no way to operate the ships at a profit. But we have the ships and in case of any future untoward happening as that of 1914 we would be in sore straits to replace the tonnage, if we let go of it now, thereby permitting our foreign commerce to go to foreign ships as is sure to happen if we do not keep pace with other nations in providing facilities and aid, where needed, to those engaged in ocean navigation.

Might Solve Shipping Problem

No one better than the engineer can weigh all the elements of this shipping problem—the care of the ship particularly while tied up; its adaptability to the shipper's requirements; the overhead and the depreciation and the world's need for tonnage based on the agricultural and industrial output offered for exchange between countries; the growing, or declining market, and the passenger requirements. Are engineers put on the Shipping Board to give thought to any of these problems? No, they are not wanted. If called upon at all it would in all probability be in the same spirit that the blacksmith is sent for to sharpen the ploughshare or the tinker to solder on the spout of the teakettle—not as should be the case, to put some of the responsibility on his shoulders of shaping a policy.

Would it not naturally occur to the engineer if he were given some responsibility in the shipping problem that we are dealing not with the abstract question of whether or not it is a wise proposition for the United States to own and operate merchant ships; but having ships representing a very considerable tonnage and desiring to have at all times an American merchant marine, particularly for service in case of war, and desiring, further, to see at least one-half of our ocean commerce handled by American ships—would it not, we ask ourselves, occur to the engineer to reconcile the present condition of government ownership with the interests of the operators is this can be done? Some of the ships the operator wants. Competition in his business by the United States he does not want, particularly not if, as in the past, the United States conducts its transportation business at a loss. Would it not be natural for an engineer in such circumstances, if he had authority, to say to the operator, "You need the tonnage. The United States would rather have its ships in use than riding at anchor. Consider, therefore, some such proposition as the following: Accept from the United States such tonnage as you as an operator of ships need without cost and without fixed rental. This tonnage shall be yours to use as you see fit, but without transfer of ownership. Instead of compensation to the United States for use of the tonnage you will pay into the United States treasury annually the amount of the estimated annual depreciation, in order that the United States, out of moneys thus received, may be in position to replace ships that are lost or that are condemned, thereby not alone maintaining the aggregate tonnage which it has placed in use, but also renewing the same from time to time, doing so with tonnage of a character best adapted to your requirement. To this extent, then, you will be quite as well off as though a present had been made to you of the ships you need. Should it now happen that your business prospers, then, and only then, will the United States ask that you share the profits with the United States returning to the United States one-half (or some other proportion) of the earnings per ton that

would be returned to any private shipowner participating in your business on a tonnage basis." Such a proposition could not, of course, be made to any but a responsible operator and would have to be coupled with obvious restrictions relating to the amount of tonnage that any single concern would be allowed to control, and the right to recall tonnage under certain contingencies would have to be reserved.

Loan Ships to Operators

Under such an arrangement the operator would be far better off than if he must secure capital for the construction of the ships he needs. He would have no interest to pay on the cost of the ship and would put no larger sum into the depreciation or replacement account than if he were making provision for the replacement of his own tonnage. If his business is not profitable there would be no further payment to the United States. If it turns out to be profitable, then, of course, a small return for the loan of capital which is made in the shape of tonnage, will go, as it should, to the United States.

General acceptance of such a program, would undoubtedly result in some return to the United States beyond that which is required for tonnage replacement. Some transportation companies would certainly do business at a profit in which the United States would have a moderate share. Funds thus received would then be available to meet any subsidy payments or other aid to shipping that might from time to time be authorized by the United States.

The Shiping Board problem will suffice to illustrate the kind of service which could be rendered by the engineer if he were placed on such boards. His training and experience qualify him peculiarly to analyze such problems. Why should not a share of the responsibility fall to him?

Of course, as already intimated, we should not assume that all engineers have the other essential qualifications that go to make good material for a place on the Shipping Board or on the Interstate Commerce Commission or on like organizations, but these other qualifications are quite as likely to be found in the engineering profession as anywhere else.

Should Forget Personality

You were told some months ago by Public Works Commissioner Sprague, of Pittsburgh, Pa., if I am correctly informed, that it is time for the engineer to get out among the politicians and take his place among those who solicit political preferment. We may talk a good deal about doing this, but the engineer will be found slow to find the way to do it and he will ever ask himself, "Is it desirable? Can I afford to do it?" To this I would make a suggestion, by no means a novel one, and yet one that is slow to sink in. The engineer owes it to himself and to the community in which he lives to forget at times that he is an engineer. He must function with the rest of the community as a plain citizen. He should participate with his neighbors in a consideration of their local problems; the school, the improvement of the street, the selection of councilmen, the type of his city government and like matters should receive his attention. He should not dodge service on juries, nor the call of the Chamber of Commerce. But heeding such calls, he should above all else, forget that he is an engineer and should meet his fellow citizens on the same plane on which they stand.

Where the engineer in more recent times has entered public life, he has left an enviable record. Perhaps someone some day will write the record. If we feel disappointed that because the engineer has not been, in recent years, more conspicuous in public life, despite the recognition which is being accorded the profession for the wonderful progress which the world is making, attributable in no small part to the efficiency of the engineer, we must remember that engineers, considered as a class, constitute but a small fraction of our population. It is quite possible that an analysis would show that in comparison with other vocations—newspaper managers and editors, of course, excepted, the engineer does not fall far behind the average good citizen in the giving of attention to public affairs. We are, I think, all inclined to believe that in this respect he does not come up to the average. And we want him to do far better in this particular. He should be found well in the lead.

Some Engineers Now Giving Notable Service

General Jose Maria Orellana, the president of Guatemala, who has recently put Guatemala on a sound financial basis, with notable improvements in educa-

tional matters, sanitation, water supplies and the like, is a civil engineer by profession. He is a graduate of the Military College of Guatemala.

No doubt other examples could be added to those already mentioned. The many responsibilities that were placed on the engineer during the war, the great extent to which the country found itself dependent on the engineer, and the good account which he gave of himself have gone far to secure deserved recognition of the value of the profession to society. It is only a few years ago that the engineering profession was among the last that the public thought fit to furnish managers for large enterprises. And now city after city is seeking for its manager an engineer. I need cite only Niagara Falls, N. Y.; Dayton, O.; Norfolk, Va., and Stockton, Calif., to show the trend in this matter.

Gelasio Caetani, a prominent Italian engineer, whose activities in the war will be remembered, now represents Italy as ambassador at Washington.

Should Act as a Body

Not alone in his individual capacity but by collective effort should the engineer make his contribution to human progress. The engineering organizations generally should follow the example of your own society and concern themselves with civic problems. Not alone those which involve technical questions, but those which involve financial and economic problems and the broader policies of conservation of the natural resources, are fit subjects for study and for constructive action by the profession as a body. Where better than in our greater engineering organizations can the policy of water conservation, for example, be discussed and given shape with a view to securing ultimately the greatest good to the greatest number? The merchant marine problem has already been referred to. It is worthy of close study. And then there are such problems as that of the best standard of value. Whoever has had to make an appraisal, particularly if the same is needed as a basis for rate fixing, can not fail to have been impressed with the fact that the yardstick with which he makes his measurement—the dollar—is constantly changing in value. Value of anything, as we all know, depends on the necessary and desirable things obtainable in exchange. It is convenient to express this value in terms of money, which has become an indispensable medium of exchange. The dollar, or for that matter any other unit of currency, serves acceptably as a standard of value, whenever the time element is not involved in a transaction, as for example, when a hat is purchased for cash. The hat is readily evaluated in dollars. It is quite another matter, however, when the transaction involves deferred payments, as in the case of fixing salaries and wages. During the war many of you no doubt have experienced in exaggerated form the effect of the shrinking value of the dollar. The salary that was acceptable in 1914 based on the food, clothing, shelter, education, transportation and recreation which it would buy was entirely inadequate in 1919 and 1920 at the peak of high prices, when the dollar was at its lowest value and would buy less than one-half as much as five years earlier. Against such shrinkage the engineer along with everybody else employed on a salary basis has but inadequate remedy. The laboring man is better protected. His wages are more frequently adjusted, and, in fair measure generally—sometimes, however, too rapidly and sometimes too slowly rise and fall with the cost of living. It is not my purpose to discuss the causes of the fluctuating value of the dollar nor even to point out the great hardship that resulted to many during the war due to the shrinking purchasing power of the dollar, but I desire merely to indicate that this problem of providing a suitable remedy for this condition, is one that should interest the engineer as well as the economist. This problem should receive the attention of the engineer individually and collectively. No solution yet offered has been found acceptable. Other matters of national, state and local concern could be enumerated that are particularly deserving of the attention of the engineer in his capacity as a citizen because of their intimate relation to the engineering field. Constructive suggestions by engineers can not fail to be helpful and through such suggestions the engineer will find the doors opening to him and before he knows it he will find himself in public life and will, let us hope, become an ever increasing factor of the community, the state and the nation.

SOME PROBLEMS IN THE OPERATION OF IMHOFF SEWAGE TANKS

By Earle L. Waterman, Associate Professor of Sanitary Engineering, University of Iowa, Iowa City, Iowa

The Imhoff tank is a two-story settling tank. Tanks of this type have been built in nearly every state in the Union. It is estimated that about one-third of all sewage settling tanks used in municipal plants in the United States are of the Imhoff type.

The essential features of an Imhoff tank are the settling chamber, sludge compartment and gas vents. Sewage entering the tank flows through the settling chamber at such a low velocity that about 60 per cent of the heavier solids sink down to the sloping bottom of the settling chamber and then slide down through slots into the sludge compartment. The slots are so arranged that the gas, which is a by-product of the sludge digestion, cannot rise through them and into the settling chamber. In a septic tank, which is a one-story tank, the gas does rise through the sewage which fills the tank and in doing this lifts some of the partially digested sludge back into the sewage. As a result the effluent (water flowing away) from the septic tank contains a higher percentage of suspended matter than that which leaves anI Imhuff tank. Thus we see oue of the important reasons for having a two-story tank.

Besides preventing the re-suspension of settled solids in the sewage, the design of an Imhoff tank also prevents the liquid as well as the gaseous products of sludge digestion from coming into contact with the sewage as it passes through the settling chamber. Experience hass hown that by preventing such a mixture an effluent is obtained which is more readily treated in subsequent processes.

Gas As a By-Product

The compartment underneath the settling chamber, into which the solids fall as they pass through the slots, is called the sludge compartment. This is a storage space in which digestion or rotting of the organic matter which has settled from the sewage takes place. Digestion of this organic matter is very largely the result of the activities of innumerable bacteria. As the fresh particles of suspended matter come into the sludge compartment the bacteria attack it and break it up into different products, some of which they utilize as food. During this process considerable quantities of gases are formed—the principal one being methane, which is the same gas that is used for illuminating and heating purposes. Recently the engineers of the Emscher Drainage Board in Germany have devised a method for collecting the gas from Imhoff tanks so that it may be used. In one instance, the supply collected is sold to the municipal gas company and is used in the same way as that manufactured in the company's own plant.

In the Imhoff tank the gases which form during the process of sludge digestion rise until they strike the sloping bottom of the settling chamber which deflects them into the gas vents from which they discharge into the air above the tank. As the gas rises some of the finely divided sludge is lifted by it to the surface of the gas vent and in time a scum of considerable thickness is formed. If this scum is allowed to accumulate it will act as a cover on the vent and will be gradually lifted as the pressure of the gas below it increases and will eventually be forced out over the sides of the vent and fall back into the settling chamber. In order to prevent this it is essential that the scum be broken up frequently so that it will fall back into the sludge compartment and allow the gas to escape freely.

A considerable portion of the solids which fall into the sludge compartment is left after the bacteria have completed their work on it. This is now what we called digested or ripened sludge and contains a very large percentage of moisture. As the tank continues in operation there is a gradual accumulation of ripened sludge and eventually the amount becomes so large that it is necessary to draw it out of the tank through the sludge pipe. Properly digested sludge as it is drawn from the tank has the appearance of thin black mud. It usually flows readily and is allowed to run out into sludge-drying beds. In fair weather it will drain and dry in a week or ten days so that it can be easily handled with spades. It should then resemble dark garden soil and have about the same physical characteristics.

Operating Procedure

If Imhoff tanks are to accomplish the results for which they are designed, namely—give an effluent comparatively free from suspended solids and the prod-

ucts of sludge digestion and produce a sludge which is free from disagreeable odors and which will dry readily—careful and systematic operation of the tank is necessary. Experience has shown that attention should be given to the following schedule of operation.

Cleaning Screens and Grit Chambers

Coarse screens are usually installed for the purpose of removing coarse material such as rags, pieces of wood, and other foreign substances from the sewage before it enters the Imhoff tank. These screens should be cleaned daily and the screenings buried. Where storm water is handled by the same sewer that carries the domestic sewage, grit chambers are built for the purpose of removing the sand and other heavy material from the sewage before it flows into the Imhoff tank. Grit chambers should be cleaned after every heavy rain.

Cleaning Sides and Bottom of the Settling Chamber

Once every week the sides and bottom of the settling chamber should be cleaned. Very frequently growths attach themselves to these surfaces and serve as miniature catch basins for the settling solids. Unless they are removed undesirable septic action may be started in the settling chamber. This cleaning should be done with a squeegee (a hardwood board 12 to 15 in. long and 3 to 4 in. wide having rubber edges and attached to a handle which is of sufficient length to reach down to the slots in the bottom of the sedimentation chamber). A heavy chain attached to the end of a rod may also be used to clean the slopes and slots in the bottom of the settling chamber.

Removing Floating Material From the Sedimentation Chamber

Material such as grease, matches, corks, etc., and sometimes scum, which floats on the surface of the sedimentation chamber, should be removed with a skimmer and placed in the gas-vent chamber. If this is not done septic action may start. As we have already noted, septic action is undesirable in the sedimentation chamber. A very satisfactory skimmer may be made from woven wire having about ten meshes to the inch. A hoop of ¼ in. iron rod is attached to a long wooden handle. The woven wire is bound to the hoop in such a way as to form a dish-shaped skimmer.

Equalizing the Deposit of Sludge

If the construction of the tank permits it is advisable to reverse the direction of flow through the sedimentation chamber. As the sewage flows through the tank a large part of the suspended matter settles out near the inlet. This results in building up a sludge deposit which is higher near the inlet than it is at the outlet. By reversing the direction of flow once every month a more even distribution of the sludge deposit can be obtained.

Treatment of Scum on the Gas-Vent Chamber

The scum which forms on the surface of the liquid in the gas-vent chambers should be broken up at least once a day. If this is not done the action of wind and sun will form a tough leathery surface through which gas cannot pass. The result is that the scum is lifted by the confined gases and is sometimes pushed over the side wall of the vent chamber and falls into the sedimentation chamber. Even in Imhoff tanks where housing protects the scum from weather action there is often a tendency toward consolidation of the scum on the surface. The breaking up of the scum may be accomplished with hoes or by water from a nozzle. In one case which has recently been reported a walking beam has been arranged so that continual agitation of the scum in the vent chambers is obtained. This of course required some kind of power but in the case referred to the results have apparently justified the expenditure for equipment and power. This matter of keeping the gas vents functioning properly seems to require more attention on the part of the operator than any other single phase of Imhoff tank operation.

Observing Depth of Sludge

It is important to know the depth of sludge in the sludge compartment. Observations to determine this depth should be made at least once a week. If the sludge compartment is divided into two or more pockets the depth of sludge should be determined in each pocket. This may be done by means of a sheet-iron plate 12 to 18 in. square attached to a wire or cord or long, light, wooden rod in such a manner that it will sink in a horizontal position. When it reaches the top of the sludge the rate of sinking will be checked and at this point the depth should be observed. This observation can generally be made through the gas-vent chambers.

Drawing Sludge

In a normally operating Imhoff tank, sludge should be drawn when the sludge

compartment is filled to within 20 in. of the slots. The valves in the sludge-outlet pipes should be opened very slowly. As the sludge begins to flow freely close the valve, let it remain closed for 2 or 3 minutes and then slowly open it again. By doing this a chance is given for the heavy sludge in the bottom of the sludge pockets to start moving toward the sludge pipe. Quick opening of the valves may result in drawing sludge from the top instead of the bottom of the compartment. If there is water supplied to a perforated pipe near the bottom of the sludge compartment the valve controlling it should be opened just before sludge is to be drawn.

There is danger of drawing too much sludge at one time. The partially-digested sludge should be left in the tank to seed the sludge compartment. Otherwise the process of sludge digestion will be temporarily retarded each time the sludge is drawn. No fixed rule for determining the proper amount of sludge to draw at one time can be given. It is the writer's practice to close the sludge valve when the outflowing sludge begins to change from a black to a gray color. However, this rule probably will not be applicable to all tanks and each operator must learn from experience when to stop drawing the sludge.

In addition to drawing sludge when the sludge compartment is nearly filled, it is often advisable to draw it in small amounts when there is any evidence of "foaming" in the gas vents. The writer believes that it is better policy to draw small quantities of sludge frequently rather than large amounts at long intervals.

Drying Sludge

A well-drained sludge-drying bed is a necessary accessory to an Imhoff tank. Sludge drawn from the tank is either pumped to or flows by gravity to the sludge bed. It is not advisable to cover the bed to a depth greater than 12 in. In from ten days to two weeks after it is applied to the sludge bed (during fair weather) the sludge should dry enough to be easily removable with hoes and shovels. This should be done promptly so that the bed may be ready for the next application of sludge. In some cases the drying of the sludge may be hastened by mixing a solution of alum with the sludge just before it enters the drying bed. Recent experience at Plainsfield, New Jersey, where 1.35 lbs. of alum per cubic yard of wet sludge was applied to the sludge, indicates that a considerable saving of sludge-drying time can be effected. The method of applying the alum is very simple.

Operating Problems

The difficulties encountered in the operation of Imhoff tanks may be summarized as follows:

1. Occurrence of septic action in the sedimentation chamber which results in a cloudy, odorous effluent.
2. Clogging of slots which prevents proper disposition of sludge.
3. Clogging of sludge pipes.
4. "Foaming" at the gas vents.

In a well-designed Imhoff tank most of these difficulties arise as the result of inefficient operation and may be overcome by carefully following the operation procedure outlined above. In some instances, however, troubles are the result of faulty design. It may be that the designer has not fully understood the principles which control the operation of an Imhoff tank, but more often trouble arises from the fact that the tank is called upon to do more work than the designer planned. Whatever the reason for operating difficulties it is surprising to see what can be acomplished by a careful, conscientious, and skilled operator.

Prevention of septic action in the sedimentation chamber, clogging of slots and sludge pipes may all be prevented by following the suggestions which have been made. When the sludge pipes do become clogged, however, there are different ways of getting them cleaned out. If water under pressure is available, a hose with attached nozzle may be dropped down the sludge pipe. A stream of water from the nozzle will frequently dislodge the obstruction. If this does not succeed a soil auger attached to a shaft of sufficient length to reach the bottom of the sludge compartment should be tried. By twisting the auger and lifting it carefully the obstruction may be removed. If an auger is not available a hook will serve the same purpose. Usually the obstruction is formed by rags and this fact should be kept in mind when attempting to clean out the sludge pipe. In some cases, however, the clogging is due to the solidification of sludge.

"Foaming" is an abnormal boiling of the gas vents. Under certain conditions gas seems to be produced in large quantities in the sludge compartment and

rises so rapidly in the vent chambers, carrying finely divided sludge with it, that the scum on the vent chambers is lifted until it overflows. The causes of foaming seem to vary. Overloading of the plant, excessive accumulation of sludge, inadequate gas-vent area, oil from garages, septic sewage, and wastes from creameries have all been charged with causing foaming conditions.

During the past summer the writer had some experience with "foaming" in an overloaded tank and has seen the gas vents boil over five times in one day in spite of thorough hosing of these chambers. The sludge produced by the tank in quesition had a practically neutral reaction—it was neither acid nor alkaline to litmus. And yet the addition of hydrated lime to the tank every other day certainly decreased the foaming tendency although it did not entirely eliminate it. The tank in question was designed in 1916 to treat the sewage from a population of 2,000—the sludge compartment had a capacity of 2,500 cu. ft. or 1.25 cu. ft. per capita. The tank is now receiving sewage from a population of 3,000—hence the overloading. Experience seems to indicate that a sludge capacity of 2 cu. ft. per capita should be provided. The permanent remedy for an overloaded tank is obvious. Additional tank capacity should be provided.

Drawing of sludge frequently and in small amounts will often correct foaming conditions. In some cases the installation of fine screens ahead of the Imhoff tank is efficacious. Such a procedure really amounts to reducing the load on the tank. Wastes which make the sewage acid, such as those from creameries should be treated separately. If for any reason they are temporarily present, lime should be added to neutralize them.

Conclusion

The difficulties which are met in operating an Imhoff tank can be very largely eliminated by following an operating schedule which calls for the performance of certain duties at regular intervals.

If difficulties arise which are not overcome by ordinary methods, it is advisable to consult an experienced sanitary engineer.

This paper by Prof. Waterman was presented at the Fifth Conference on Sewage Treatment at Ames, Iowa, in October, 1923.

CRITICISM OF THE SEPARATE CONTRACT SYSTEM

High interest for the entire construction industry is held in the fact that a government agency has refused to accept the theory that economy is promoted through the "separate contract system" under which indicidual agreements would be made between owners and those handling district installations such as plumbing, heating equipment, electrical fixtures and wiring.

The Interdepartmental Board of Contracts and Adjustments, an agency created by General Dawes while he was head of the Bureau of the Budget has adopted a resolution which has the effect of refusing to abolish the general contract system from federal construction operations. This resolution was adopted by the board in answer to the request for adoption of the separate contracts procedure made by a joint committee of the National Association of Master Plumbers, the Heating and Piping Contractors' National Association and the Association of Electrogists-International.

The claims made by this committee in favor of the separate contracts system were replied to in a brief filed with the board by the Associated General Contractors of America, it being through this brief that firm case for the joint contract system was established.

The board's decision acquires an added importance, it is pointed out, because of the effect which it will carry into the field of construction work other than that carried on by the government.

The text of the resolution, pointed to as emphasizing the necessity for general contractors' services in building operations, follows:

"Whereas a joint committee of the National Association of Master Plumbers and the Heating and Piping Contractors' National Association and the Association of Electrogists-International, has requested the Interdepartmental Board of Contracts and Adjustments to take such action as will require the various departments and independent establishments of the Government, in connection with the performance of public works, to advertise separately, and contract separately, for the portions of the work which pertain to their respective specialties; and

"Whereas this board has taken this question under careful advisement and has heard the arguments of the above-

mentioned associations; of the representatives of the various departments and independent establishments of the Government; and of numerous general contractors; and

"Whereas in view of the evidence produced, taken together with the experience of competent government officials familiar with construction work, the board believes that the granting of this request of the associations above-mentioned would—

"(a) Unduly restrict the freedom of action of the heads of departments;

"(b) Be of doubtful value from the standpoint of actual economy in many, if not in the majority of cases;

"(c) Result in placing responsibilities and duties upon supervising government officials which they are not always in a position satisfactorily to perform;

"(d) Take away from the Government any advantage which it might otherwise secure from the utilization of a general contractors' organization and powers of properly timing and coordinating the various parts of the work; and

"(e) Tend to delay the performance, give rise to claims for delays of one contractor by another, and create difficulties which are largely avoided when the work is performed under one contract. Therefore be it

"Resolved, That it is the opinion of the board that it is to the interest of the United States that no action be taken which would place any restriction upon the authority of the heads of departments or independent establishments to exercise discretion as to the manner of awarding contracts or sub-dividing the work to be done; be it further

"Resolved, that the question of the advisability of sub-dividing contracts in specific cases be called to the attention of contracting officers in the manual of instructions now being prepared by the board."

F. L. Cranford, Brooklyn, N. Y., president of The Associated General Contractors of America, commenting upon adoption of the resolution, said:

"It is almost axiomatic that states, cities and counties should turn to the Federal Government in determining their practices with respect to contract forms and practices in construction. Certainly if the Federal Government could establish fundamental laws and under these laws acceptable standard contracts and practices, in due course of time the way could be appointed for other governmental agencies to do likewise.

"If we assume that there had been no national organization of general contractors to present the matter of separate contracts for mechanical equipment of buildings is it not conceivable that the Joint Committee of master plumbers, heating and piping contractors and electrical contractors would have fastened on the Federal Government a practive which some of the states, unfortunately, have written into their laws? Should this practice become general in all of our governmental agencies, is it not logical to assume that other sub-trades would follow in its wake and gradually the business of general contracting be legislated out of existence? Is it not plain that the general contractors who work far from the metropolitan centers and in small towns, or even in the country, are vitally affected by such procedure as this?"

SOLVING THE EARTH MOVING PROBLEM ON ROAD CONSTRUCTION

The biggest of the many problems which must be faced by the road construction contractor in the building of large sections of hard-surfaced roads has recently been solved by the R. F. Conway Construction Company of Chicago. For many years this well-known road construction organization, well-known for the magnitude of its operations and its careful analysis of equipment problems, has like other contractors, had to depend upon sub-contractors using teams and miscellaneous equipment for preparing the grade, moving dirt and in all of the various operations connected with road building.

Though these subcontractors be the most conscientious operators, though every condition be perfect it has always been practically an impossibility to keep everything moving at a uniform rate that would insure all of the equipment in use rendering the most effective and efficient service. And anyone who has had any experience in road building operations knows too well that, if the grading and other preparatory work does not proceed uniformly, paving operations suffer costly and trying delays.

On a recent contract calling for a 53-mile hard road in Illinois the R. F. conway Co., solved its problem by motoriz-

ing the job with nine 10-ton "Caterpillar" tractors. In connection with these the company bought a large fleet of self-loading wheel scrapers and blade graders. All dirt moving and grading operations on this job are "Caterpillar" hauled. Each tractor is handled by an especially selected operator and the entire personnel has been selected with a view to getting the best possible service out of the machinery employed.

Contractors have never figured any way to profit financially from "trimming" and "shouldering." On this job, however, the Conway Company has found that "Caterpillars" perform these operations at approximately half the ordinary cost, thus giving a profit. One "Caterpiller" pulls four scrapers on one turn and one man handles the loading of the four. These scrapers have a capacity of 1¼ yds.

Another highly important fact in connection with this job is that fewer men are employed, in fact less than half. Under ordinary circumstances the average number of men and horses employed would be 63 of the former and 23 of the latter. Three "Caterpillars" and 10 men comprise each camp outfit, making a total of nine "Caterpillars" and 30 men working on this job. Three camps are being maintained, all under the direction of one superintendent.

The Conway Company reports general speeding up all along the line of operation, dirt movers, pavers and graders moving from point to point in an orderly and uniform manner. The savings in time, temper, money and general wear and tear on the dispositions of the men are items too important to be ignored by anyone interested in the highly exacting and precise business of building the nation's roads.

In every phase of road construction machinery is, of course, playing a more and more important part, but in no phase has machinery become so essential as in moving dirt in preparation of grades for roads. "Caterpillar" tractors have long pioneered in these operations. Their dependability under any and every condition of road and weather, their ability to move the load from where it is to where you want it to be, the fact that they travel on their own "hard road" and do their husky assignment of work day in and day out; these are items which have been jotted down in the mental note-books of construction contractors everywhere, items which have contributed to the universal appreciation of these modern marvels of hauling machinery.

MOVING HEAD WALLS OF PIPE CULVERTS

An economical plan for the extension of pipe culverts, without the destruction of the headwalls, has been used successfully by the engineers of the California State Highway Department between San Diego and Oceanside, where widening and repaving of the state highway is under way. The method used is described in a recent issue of "California Highways."

A special maintenance crew was employed and headwalls for both corrugated and concrete pipe culverts were moved in record time by the use of a hoisting frame, designed and built at the division shops at Lankershim. This hoist consists of a 10-ft. length of 6-in. I-beam, supported by four 2-in. pipe legs, capable of adjustment to a height of 6 to 8 ft.

A trolley carrying a 2-ton Wright chain hoist was operated on the I-beam, adjusted to move freely along the full length of the hoisting frame.

Methods Described

Excavations were made around headwalls and down to the bottom of the footing and extended out from 6 to 10 ft. to provide room for moving. The excavation also extended from 2 to 3 ft. back to permit disconnecting with concrete pipe or cutting corrugated metal pipe about a foot back of the headwall.

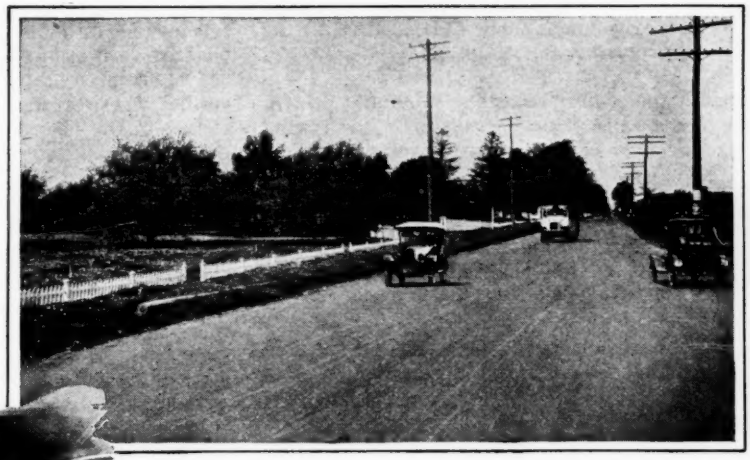
After cutting the pipe, the hoisting frame was lifted into place. The hoist chain was hooked on the back above the pipe and a turn taken around the top of the headwall, just below the offset. The headwall was then raised and moved out to its new location by means of the trolley.

Corrugated metal pipe extensions were fastened in place with two band couplings, while concrete extensions were made with 2-ft. sections of pipe laid with mortar in the usual manner.

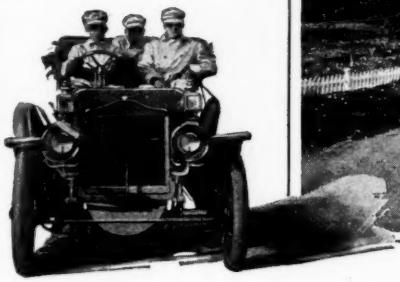
Fast Work Cuts Cost

Fifteen to 35 minutes was the time required for moving headwalls, varying in weight from 1,800 lbs. for the 12-in., to

(Continued on Page 108)



The Dixie Highway, north of Toledo, O. Tarvia-built 1910.



This 1910 car has chugged its last chug —this 1910 Tarvia Road is still good

IMAGINE the car pictured here snorting up to your door tonight. Yet that car was modern when the Tarvia pavement was laid on the Dixie Highway—back in 1910.

Those old-time cars have gone their way. But the Tarvia pavement of this heavily traveled section of the Dixie Highway, after fourteen years of ceaseless motor traffic, is as good as the day it was laid.

Only the most economical maintenance is necessary to make a Tarvia pavement last indefinitely. And these facts in addition: A Tarvia pavement will not wave, roll or rut. A Tarvia pavement is skid-proof, because of its granular surface.

Thousands of Tarvia streets and roads have proved to taxpayers that for the money spent Tarvia gives more mileage and the most years of satisfactory paving service.

On request, we will gladly send you descriptive booklets, construction data and specifications.

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New York	Chicago	Philadelphia	Boston
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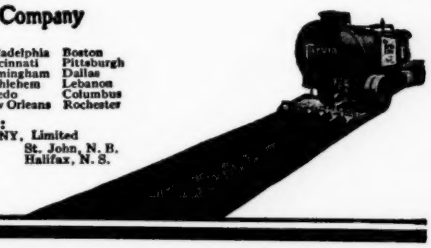

3,900 lbs. for the 24-in. The work included placing the hoist frame, and lifting and moving the headwall a distance of 6 to 10 ft.

The average cost of moving 30 12-in. headwalls and extending corrugated metal or concrete pipe culverts was $5.15 for excavating and back filling, $1.35 for cutting pipe and moving cut headwall, and $3.25 for setting in pipe extension, making the total cost for extending one end of a 12-in. pipe culvert $9.75. About 20 of the 30 of this size moved were of concrete pipe.

Headwalls for 12 18-in. corrugated pipe culverts were moved an average of 10 ft. and the pipe extended at an average cost of $7.96 for excavation and back filling, $1.75 for cutting pipe, moving out and leveling up, and $2.74 for setting in the pipe extension, or a total of $12.46.

The average cost for 8 24-in. corrugated pipe culverts, moved an average distance of 7 ft. and the pipe extended, was $12.60 for excavation and back filling, $2.85 for cutting pipe, moving out and leveling up, and $3.25 for setting in the pipe extension, making the total cost for extending one end $18.70.

On the Lost Angeles-Bakersfield highway, between Quail Lake and the Kern County line, a widening program is in progress. Headwalls on this work are being moved at approximately the same cost as those on the San Diego County job.

Here a 2-ton Yale differential block is hung from a tripod made with 3-in. pipe legs, each 20 ft. long. The legs, and a U-strap from which the block is hung, are fastened together with an inch bolt. For moving headwalls, the tripod is set so that the block hangs freely over the new location. As the headwall is lifted, it slides out to its final position.

The tripod hoist folds up and is easily moved from place to place. It is adaptable where headwalls are located on steep side slopes, but in level country the frame with the I-beam trolley is preferable.

VALUABLE TRADE LITERATURE

(Editor's Note: Copies of the literature here briefly reviewed may be obtained by writing to the addresses given or to this magazine.)

Improved Street Lights.—A great improvement in the efficiency of nonornamental street lighting is made possible by the new Holophane 4-way and 2-way refractors. A bulletin of 12, 8x11-in. pages, issued by the Holophane Glass Co., 346 Madison Ave., New York, N. Y., describes these refractors. Greater efficiency in the use of the light is not the only advantage obtained by these refractors. There are other important savings made possible by the accurate way in which light is distributed over the street. These advantages are given in detail.

Tractors.—Two folders were issued recently by the Holt Manufacturing Co., Peoria, Ill., covering the use of "Caterpillar" tractors in all kinds of road building operations. Numerous applications of these tractors are illustrated and described. Condensed specifications are given. One of these folders relates to the 2-ton "Caterpillar" and the important uses of this unit on every road job are enumerated and discussed.

Expansion Joint.—An attractively printed book of 72, 8½x11 in. pages was issued recently by The Philip Carey Co., 40 Wayne Ave., Lockland, Cincinnati, Ohio, on the Carey Elastite expansion joint for the elimination of expansion troubles. The use of these joints in road and bridge work is very fully illustrated and described. Detailed instructions on the use of Elastite joints are given.

Drainage Gates.—Eight important uses of the "Calco" automatic drainage gate are illustrated and described in a booklet of 12, 6x9-in. pages issued by the California Corrugated Culvert Co., West Berkeley, Calif. There are outlet gates that allow free passage of water whenever required and at all other times are closed automatically, either from their own weight or from back pressure of water.

Caterpillar Tractors.—Bulletins cover the 5-ton and 10-ton caterpillar tractors have recently been issued by the Holt Manufacturing Co., Peoria, Ill. Detailed descriptions of these tractors are given.

Paving Mixers.—The T. L. Smith Company, Milwaukee, Wis., is distributing its 1924 paver catalog. It contains complete descriptions of the Smith Paver models and their outstanding features, together with many half and full-page illustrations of Smith Pavers "in action." This year's catalog is especially attractive, being printed in three colors throughout and having an extra strong binding.

Contracts Awarded

ROADS AND STREETS

Ariz., National Forest Rd.—Downer & Mero, Richmond, Cal., contr. by U. S. Bureau of Pub. Rds., at $143,835 for grading and surfacing Flagstag-Angel forest hwy., in Coconino Co.

Ark., Pine Bluff—J. P. McNulty, Pine Bluff, awarded contract at $100,000 to pave 20 blks. in Dist. 72.

Cal., Hawthorne—Geo. R. Curtis Paving Co., contract for improvement of Truro and Eucalyptus Aves., at $54,411; Geo. R. Curtis Co. contract for paving Broadway—Birch to Prairie Aves., at $47,-041.

Calif., Los Angeles—Wells & Bressler, 3 California Bank Bldg., Santa Ana, contr. for impvt. of Washington Blvd., at $252,455. 2.45 mi. involving 86,392 sq. yds. conc. pavement and other incidental items. Griffith Co., 502 L. A. Ry. Bldg. contract for impvt. of Ballona Ave., at $71,000; (1.94 mi. Willite).

Cal., Santa Barbara—Chas. W. Wimmer, Bakersfield, awarded contr. for constr. of about 25 miles macadam roadway in Santa Ynez Valley Rd. Dist., at $283,360.

Cal., San Diego—Griffith Co., 25 14th St., San Diego, awarded contract by Council for impvt. of Mission Blvd. and portions of other streets, at $115,-650. Impvt. will be about 3 miles 5-in. cement conc. pavement, also contract for improving Normal and other streets, at $153,432; Steele Finley, Santa Ana, awarded contract for impvt. of portion of San Luis Rey Rd. No. 2, 3.37 miles; also impvt. of Highland Ave., 8206 lin. ft. at $92,259; H. H. Peterson, Loma Portal, awarded contract for improving Coast Blvd. and portions of other streets at $23,034.

Cal., Southgate—Hall-Johnson Co., 1611 E. Sixth St., Los Angeles, contract for impvt. of Santa Ana St. at $46,737—grading, conc. gutter, Willite pavement on 3½-in. bitum. base, etc., also contract for paving west part of Santa Ana St., at $47,693 involving 110 ft. curb; 10,757 ft. 6-in. gutter; 8-in. gutter, 166,965 sq. ft. grading, 166,965 sq. ft. 1½ in. Willite on 3½-in. base, etc.

Fla., Bradentown—H. R. Curry, General Contractor, awarded contract for grading and paving street, constructing sewers, extending water lines, etc.; concrete work to N. J. Trudell, (both Bradentown) at total of $155,500.

Fla., Daytona Beach—Southern Paving & Construction Co., Chattanooga, Tenn., awarded contract for 55,000 sq. yds. paving, 2-in. asph. conc., Willite process, at $166,155.

Fla., Madison City—Inglis Construction Co., Jacksonville, awarded contract for 65,000 sq. yds. conc. paving, at $177,128.

Fla., Miami—R. G. Lassiter & Co., Citizens' Bank Bldg., Raleigh, N. C., and T. B. McGahey Co., Morgan-Hill Paving Co. and H. L. Clark & Sons, N. E. 56th St. and 2nd Ave. all Miami, at $597,-930 to pave streets in Hwy. Impvt. Dist. 224 to 237, with asph. macadam, sheet asph. and bitum. macdam.

Fla., Sarasota—J. H. Crawford, Sarasota, awarded contract for 16,400 sq. yds. street paving, at $107,807.

Fla., Seabreeze—T. B. Gillespie, Palatka, awarded contract to lay 63,100 sq. yds. brick pavement, at $198,450.

Ill., Springfield—Following contracts let by State Hwy. Dept.; SBI Rt. 26, Sec. 5, Ogle Co., pavement to J. J. Dunnegan Constr. Co., Shenandoah, Ia., at $5,916, also Sec. 6, at $4,902; Rte. 5, S. 27, Jo Daviess Co. pavement to A. E. Rutledge, Rockford, Ill., at $10,598; R. 2, S. 37X. pavement to Henry Zolpher & Son, Mendota, Ill., at $18,535; R. 12, Sec. 2, Lawrence Co., pavement to J. W. Etchison Co., at $145,191 and Sec. 3 to Orville Arnold, Casey, Ill., at $145,585. R. 37, S. 13 S, Williamson Co., grading to J. Webb Jones, Benton, Ill., at $9,554.

Ky., Frankfort—Following contracts let by State Hwy. Dept.: 9.27 mi. impvt. of Louisville-Paducah Rd., Union Co. to Globe Construction Co., Evansville, Ind., on bank grave. at $96,4.8; Louis Des Cognets Co., awarded contract by Div. of Maint. of the Department, for 1.12 miles impvt. Grayson-Ashland Rd. Carter Co. (contractor located in Lexington, Ky.); Georgetown Constr. Co., Georgetown, Ky., contract for impvt. of 15,133 mi. Owenton-Georgetown Rd. Scott Co., at $292,562 (D. S. vit. pipe, crushed limestone); S. M. Billiter, Covington, Ky., contract for 17.083 miles Owenton-Georgetown Rd. Owens Co., (reinf. conc. pipe, crushed limestone), at $381,371; Jno. S. Lusk, Barbourville, Ky., contr. in Madison-Rockcastle Counties on Richmond-Mt. Vernon Rd., (9.498 mi. d. s. vit. pipe) at $113,372; Mason Constr. Co. Elizabethtown, Ky., for 10.582 miles Hodgenville-Bardstown Rd. Larue Co., at $221,779 (Creek gravel D. S. vit. pipe); Ebersbach Const. Co. Pomeroy, Ohio, contract for 17.035 mi. Barbourville-Corbin Rd. Knox Co. at $555,407 (rein. conc.); Alexander Bros., Cadiz, Ky., contract for 10,155 mi. Scottsville-Glasgow Rd. Allen Co. at $125,399, (rein. conc. pipe); Louis Des Cognets Co., contract for 10.205 mi. Grayson-Ashland Rd. Carter Co. (rein. conc.-gravel aggregate) at $269,380; N. E. Stone & Co., Madisonville, Ky., contract for 7.765 mi. Christian Co. Madisonville-Hopkinsville Rd. at $154,302 (bank gravel, d. s. vit. pipe); Ellis, Smeathers & Brantley, Owensboro, Ky., 10.767 mi. Covington-Lexington Rd. Grant Co., (conc. pipe) at $227,087; Taylor, Petrie Co., Lewisport, Ky., contract for abt. 20 mi. Louisville-Paducah Rd. Hancock Co., at $218,557 (bank gravel); Tevis & Ingram, Danville, Ky., contract for 5.525 mi. London-Mt. Vernon Rd., Laurel Co., at $203,030 (rein. conc. pavement); Geo. Eady Co. Louisville, Ky., contract for 3.747 mi. Louisville-Bardstown Rd. Jefferson Co. at $175,349 (rein. conc.)

La., So. Highlands—Flenniken Constr. Co. Shreveport, awarded contract by Bd. of Aldermen, to pave 37,000 sq. yds. streets, including all of Fairfield Heights, Huron St., etc., at $150,000.

Md., Baltimore—State Rds. Commission let contracts for 8 roads as follows: Ward & O'Connell, New Amsterdam Bldg., Baltimore; Montgomery Co. 1 mi. conc., $28,606; Prince George's Co. 2 mi. conc., $43,712; Howard Co. 2 secs. 1.3 mi. conc., $36,229; 1.48 mi. conc. $48,838; Montgomery Co. 2.03 mi. conc. shoulders, S. D. Moses, Wash. D. C., $22,896; Baltimore Co., .46 mi. through Catonsville, to P. Reddington & Sons, 2 E. Lexington St. $9,047; Cecil Co., 1 mile conc. Rehill & McAllister, Northeast, Md. at $29,858; Calvert Co. 1.5 mi. gravel to Thos. Mullen, 3945 Greenmount Ave., Baltimore, at $20,344.

Mass., Boston—A. G. Tomasello & Son, awarded contract for Portland cement conc. pavement in Ayr Rd., Dalkeith St., Standard St., Beryl St., Pond View Ave. and Redlands RRoad, at $90,803; Jos. A. Singarella awarded contract, for Portland cem. conc. pavement in Centre St.—Jno. Eliot Sq. to Columbus Ave. Roxbury—at $63,320; S. J. Tomasello, contract for conc. surf. on terrace around Refectory Bldg., Franklin Park, at $3,450.

Mich., Lansing—State Trunk Line contracts let as follows: Rd. 43-4, Montcalm Co. Fairplains and Bushnell Twps. Cl. A, 16 ft. wide, 5.523 miles. to Robt. Sisco, Flint, Mich. at $36,106; 53-15, Huron Co. City of Bad Axe, 7-in. F-Pl. 36-48 wide, 0.496 mi. to Schulze & Liken, Sebewaing, Mich. at $25,-241 (est. cost cement, $7,827); 11-61, A, Mason Co. Amber, Custer, Victory and Sherman Twps., Cl. 6-in. and 7-in. F-Std. 18 ft. wide, 7.493 mi. to Rogers and Monroe, Muskegon, Mich. at $148,625 (cement, $51,585); 11-61, B. Mason Co. Victory, Sherman, Grand and Freesoil Twps. Cl. 6-in. and 7-in. F-Std. and 6-in. Std. Spe. reinf. 18 ft. wide, 8.268 mi. to Rogers & Monroe, Muskegon, at $173,-339 (cement, $57,156); 11-61, C. Manistee Co. Filer Twp. Cl. 6-in. F-Std. 18 ft. wide, 0.999 miles to Louis I. Goldberg, Scottville, Mich. at $22,044 (cement, $6,462); 14-35, Roscommon Co., Roscommon Twp. Cl. B, 16 ft. wide, 2,000 mi. to J. E. Van Dyne, Clare, Mich. at $13,168; Rd. 28-10, A, Ontonagon Co., Stannard & McMillan Twp. Cl. A, 16 ft. wide, 8.406 mi. to Clifford Bridges, Norway, at $97,743; 21-23, Shiawassee Co., Owosso Twp., Cl. 7-in. F-Std. 20 ft. wide, 1.524 mi. to J. C. Stewart & Co., Owosso, Mich. at $32,762; (cement $12,401). Fed. Aid contracts: 73, CDEF (Non T. L. Monroe Co., Lasalle and Monroe Twps. Cl. 8-in. F-Std. 26 ft. wide (4.122) miles to State Constr. Co. $104,-

263 (cement, $35,875); 67, A-1, and A-2, (T. L. 23) Washtenaw Co. Pittsfield Twp. Cl. G and DA, 3.578 mi. to Dona Jeffrey, Clarkston, Mich. at $43,394. (est. cost cement, $616). Assessment Dist. contract: Rd. A. D. 458, Allegan and Barry Co., Gun Plain and Prairieville Twps. Cl. B, 12 ft. wide, 2.271 mi. to H. A. Brog, Middleville, Mich., at $16,-594.

Minn., St. Paul—Following contracts let for paving: 1—Clement F. Sculley Equipt. Co. 212 Dakota Bldg. St. Paul, $30,200; Dale St., $27,800; Larpenteur Ave. $40,380; 2—Thornton Bros. 318 Endicott Bldg. St. Paul, Minnehaha St., $51,937; Raymond Ave., $56,987; Marshall Ave., $107,587.

New Mex., National Forest Rd.—Lee Moor Contracting Co., El Paso, contract by U. S. Bur. Pub. Rds., at $89,385 for grading and partial surfacing of Frijoles-San Ildefonso forest hwy. in Santa Fe Co.,—4.175 miles; Dooley Construction Co., Santa Fe., N. M., contract at $33,621.40 for constr. of Cimarron-Taos Hwy. in Carson Natl. forest, Taas Co., 3.57 mi. 12 ft. wide, semi-gravel surfacing.

Nev., Carson City—Sumison & Clyde, Springville, Utah, cont. by State Hwy. Dept. for constr. of State hwy. proj. 90-B, at $177,091; F. M. Maesti, Oakland, contract for constr. of proj. 76-A and 86, at $29.544.

N. C., Asheville—Asheville Paving Co., awarded contract for 650,000 sq. yds. street paving, at $250,-000.

N. C., Asheville—Howerton Engrg. Co. Temple Court, awarded contract to grade and hard surf. 5 miles rd. from Barnardsville to Democrat, at $251,000.

N. Car., Greensboro—Murray Construction Co., Greensboro, awarded contract at $1,200,000 for 21 miles asphalt pavement on concrete base: 339,900 sq. yds.

N. C., Greensboro—Robt. G. Lassiter Co., Oxford, awarded contract for about $90,000 for 2.7 mi. 16-ft. hard surf. Greensboro Pleasant Garden Rd. 5-in. rock and conc. base; 2-in. Warrenite top.

N. Car., Morehead City—West Construction Co., Kinston, N. C. contr. at about $275,000 for 60,000 sq. yds. asph. roadway paving; also walks, curbs and gutter.

N. Car., Rutherfordton—Wilson Construction Co., Rutherfordton, contract to pave 3rd, Courtland, S. Main, Hospital, Cleghorn and E. Court Sts.,—about 30,000 sq. yds. paving, at $104,000.

Okla., Madill—Madill Constr. Co., Madill, awarded contract for 6 miles conc. road—Madill to connect. with hwy. to Sulphur and Okla. City, at $151,810.

Okla., Okla. City—State Hwy. Comn. let contracts for following: Okla. County, 1 mile eastward from Choctaw, to A. A. Davis & Co. Grain Exch. Bldg., Okla. City, at $29,999; Creek Co. 8 miles through Oilton, Ward, Broks, Okla. City, at $28,-207; Kay Co. 7.9 miles from Ponca City to County line, to F. P. McElwrath, Corsicana, Texas, at $225,261.

Ore., Astoria—Soleim & Gustafson, City, awarded contract to lay 3 miles conc. pavement, 16 ft. wide on main Nehalem Hwy., at $81,396.

Tenn., Covington—J. A. Perdue & Co., Pine Bluff, Ark., awarded contract at $103,000 for conc. road from Shelby Co. line no. over Jefferson Davis Hwy.

Tenn., Nashville—Department Public Works and Highways let contracts for 10 road projects as follows: FAP. No. 29, Sec. A, Gibson Co. grade and drain 2.24 miles State Hwy. No. 5 also 2 bridges, to Cresap Bros., Humboldt, at $34,877; grade and drain 7.78 mi. State Hwy. No. 5, to F. D. Harvey & Co., 688 S. Bellvue St. Memphis, Tenn. at $46,046; also to J. A. Paterson, Montgomery, Ala., at $80,941 for 2 bridges, 31-A, Tipton Co. grade and drain 9.36 mi. state Hwy. No. 3, also 2 bridgs. to J. A. Perdue & Co., Pine Bluff, Ark., at $106,-053; 31-B, Tipton, grade and drain 7.37 mi. St. Hwy. 5, to Little & Dean, 63 S. 3rd St. Memphis, at $43,898, 3 bridges to Ellis & Smeathers, Owensboro, Ky., at $33,029; 151-C, Coffee Co. 9 mi. of macadam base course on St. Hwy. 2 to Pitt Bros. Mt. Pleasant, Tenn. at $84,387; 163-B, Kalb Co. 4 bridgs. Nashville Bridge Co. Shelby Ave. Nashville at $103,556; 167, Gibson Co., grade and drain 9.413 mi. State Hwy. 42, also 1 bridg. to S. R. Hall, Newbern, Tenn., at $58,950; 168, Madison Co., 3.66 mi. St. Hwy. 42, 26-B, also 1 brdg. to F. D. Harvey, Memphis, at $58,562; 169-A, 8 mi. rd. and 1 bridge to Ellis & Smeathers, $74,349; 169-B, grade and drain 4.60 mi. State Hwy. 21 bet. Hornbeak and F. A. P. 71-B to same contractors, at $35,067; 170 Marion Co. grade, drain and lay 16-ft. waterbound macadam base course on 4.625 mi. St. Hwy. No. 2 bet. State Aid Proj. 136 and point near Battle Creek; also 4 bridges to Brown Bros. & Co. Tracy City, Tenn. $136,923; 171, Grundy Co. grade, drain and lay 9-ft. macadam base on 5.02 mi. State Hwy 56, bet. Warren Co. line and Tarlton, also 2 bridges to Brown Bros. & Co., at $65,737.

Texas, Baird—Jordan Construction Co., Plainview, awarded contract by Callahan County to grade, construct draing. structs. and asphalt macadam surf. 8.84 miles State Hwy. No. 1, Bankhead Hwy. from Baird to Sec. 1, F. A. P. 52-B, at $136,-967.

Texas, Pecos—Reeves County let contracts to Valieant & Toomey, Inc., F & M Bank Bldg., Fort Worth, for construction of drainage structs. and gravel surface on 13.25 miles 26-ft. road on State Hwy. No. 1, at $112.628; 3.79 miles 26-ft. gravel surf. on State Hwy. No. 3, at $33,000.

W. Va., Charleston—Board & Duffield, 1012 Virginia St. contr. at $95,698; Andrews Asphalt Paving Co., Hamilton, Ohio, at $99,536; Ebersbach Construction Co., $82,208; J. E. Reed, at $12,757—all paving (36 streets).

W. Va., Wheeling—H. D. Peterson Co. Wheeling, awarded contract at $120,000 for 16,850 sq. yds. conc. paving; 10,000 lin. ft.; curb; 36,700 sq. ft. walks, etc.

Wis., Marshfield—Schaefer-Thompson Constr. Co. Marshfield, awarded contract for paving 14 blocks on N and S Central Ave. and 4 blks. on Litchfield Rd. at $108,000. Pavement will be concrete and wood block.

SEWERAGE AND SEWAGE TREATMENT

Cal., Burbank—City Engr. A. J. Rose has recommended that contract for constr. of new sewer sys. and treatment plant, be awarded to Jones Contr. Co., at $214,451.65.

Cal., Los Angeles—Leo Miletich, contract for sewer in portion of Templeton St. at $12,933; Jno. Artukovich, Bouett St. at $14,695; P. J. Anmadzich Hyperion Ave. at $10,600; Frank H. Brigham. Dover St. at $3,643; Martin G. Brkich, 62nd St. at $16,-216; E. Grancich, Ezra St., at $3,600.

Cal., Placentia—Coastland Constr. Co. 609 Mtge. Guar. Bldg. Los Angeles, awarded contract at $21,-504 for constr. of new outfall sewer using vit. pipe for work complete. Work involves 22,350 lin. ft. sewer pipe.

Ont., Toronto—Following contracts let by City for sewers; Shaw St. $1,116, A. Cavotti, 257 Euclid Ave.; Fleet St. A & B, $43,250, Commr. of Works, let contracts B and C, C and D, $51,944, to W. R. Worthington, 57 Lascelles Blvd.; Austin Crescent, L. Agri, 124 Markham St.; Floyd St. $557, W. E. Taylor, 22 Falcon Ave., Draing.: on Glenedyth draing. sys.; Cottingham Rd. $2,000 and Glenedyth Dr. $3,375, L. Agri, 124 Markham St.; Bouiton Dr. $6,436, F. Angotti, 819 St. Clarens Ave.; Roycroft Dr. $2,207, W. E. Taylor, 22 Falcon Ave.

D. C., Washington—W. Harry Angle, Hagerstown, Md. awarded contract by Wash. Suburban San. Assn., Evans Bldg., Washington, for constr. of sewerage work at Capitol Heights near Washington, at $55,136.

Fla., Bradentown—G. Skene, Palmetto, awarded contract for st. and san. sewers in various streets, at $36,000.

Fla., Daytona Beach—I. C. Mishler, Deland, Fla., awarded contract for 2 miles san. sewer system at $37,323.

Fla., W. Palm Beach—W. S. Lockman, Jr. awarded contract at $12,828 and $40,042 for constr. of storm sewer in Dists. Nos. 2 and 3.

Ky., Mayfield—Queal Constr. Co., Neosha, Mo., awarded contract at $180,000 for sewerage system.

Mass., Boston—A. Baruffaldi Co., awarded contract for filling sewerage works and water works in Ashley St.—Breed to Boardman Sts. E. Boston, at $26,969 also sewerage works in Paris St., at $2,662; M. D. Russo, contract for sewerage wks. in Iffley Rd.—Wash. St. to Walnut Ave; W. Roxbury,

at $1,537; Zoppo & Civitarese, contract for sewerage wks. in Weld St. outlet, at $11,480.

Mich., Detroit—R. A. Mercier, 5,435 Wesson Ave. awarded contr. for 4,561 ft. Wyoming Ave. Sewer Sec. 7, 1,635 ft. 6 ft. 9 in., 2,555 ft. 5 ft. 3 in. 266 ft. 5 ft. and 33 ft. 4 ft. 6 in. cylinder, at $96,813.

Neb., Friend—Arthur A. Dobson & Co. 809 1st Natl., Lincoln, awarded contract for sewers, at $40,845.

S. C., Westminster—Dysard Constr. Co., Austell Bldg., Atlanta, awarded contract for constr. of complete sewer and water system at $102,000.

S. D., Sioux Falls—Ejector contract let to Yoemans Bros. Co., Chicago, Ill.; 1 pneumatic duplex automatic sewage ejector, at $3,815; contract to Michael Fanebust, Sioux Falls, for intercepting and lateral sewers in Dist. 20, at $18,997.

Tex., Dallas—Central Bitulithic Co., Praetorian Bldg.; Dallas, awarded contract for storm sewer on McKinney Ave., at $42,750.

Tex., Dallas—Smith Bros. Inc., American Exchange Bank Bldg. awarded contract to lay sewer main from Cadiz St. to sewage disposal plant, at $173,730.

Va., Portsmouth—Duke & Smith, Lafayette Bldg. Portsmouth, awarded contract for bldg. and equipping City's sewage pumping stations at Green and Race Sts. and Douglas Ave., at $45,000.

Wis., Beloit—Pastoret Constr. Co. 506 Sellwood Bldg. Duluth, awarded contract for san. sewer at $40,359; 5,200 ft. 24-in., 360 ft. 8-in., 30 manholes.

Wis., Ladysmith—W. D. Morgan, Ladysmith, awarded contract for sewer on E. Minor Ave.—E. 3rd to Lindoo Ave., Lindoo to E. 4th St.; E. 4th to river; 24-in. vit. pipe sewer and fill and level trench, at $32,466.

Wis., Menasha—E. A. Yahr, Antigo, awarded contract for vit. clay sewers in various streets, at $39,739.

WATER SUPPLY AND PURIFICATION

Ala., Capitol Heights—Sullivan, Long & Haggerty Co., Bessemer, Ala., has contract for laying sewers here, at cost of $60,000. (Postoffice is Montgomery).

Ariz., Williams—S. P. Gillis, Phoenix, awarded contract for constr. of water works system, including necessary component parts, at $34,732.

B. C., Cranbrook—J. A. Broley, local, awarded general contr. for 3 miles water main flume and conc. dam, including 50,000 yds. rock and earth excavation, at $34,000.

Colo., Denver—A. Dutton & Kendall, 2104 Broadway, awarded contract for 64 m.g. rapid filter on no. side Marston Lake, contract A, at approx. $1,250,000.

Fla., Daytona—Elwood G. Ladd, Jacksonville, Fla., awarded contract for laying water mains, at $60,154.

Fla., Daytona—Edw. L. Guest, Savannah Ga., awarded contract for laying san. sewer system at $44,000.

Fla., Miami—Pittsburgh-Des Moines Steel Co. Curry Bldg., Pittsburgh, awarded contract for 2 steel water tanks at N. W. 36th St. and 7th Ave. at $70,975.

Fla., Tampa—Following bids approved for constr. of City water works plant, filtration and softening plant, necessary machinery and equipment; also extensions of distribution system. Est. cost $1,233,068. Sec. A.: Bldg. and structures to Gauger-Korsmo Constr. Co. 520 E. Dunlap St. Memphis, Tenn. at $466,013; Sec. B.; Filter and chem. equipment to American Water Softener Co. 4th and Lehigh Sts., Philadelphia, Pa., at $135,000; Sec. C; Pumping machinery to Burford, Hall & Smith, Birmingham, Ala. Items 1 and 2, high lift pumps; items 3 and 4, De Laval single st, turbine; items 5 and 6, substitute for vacuum pumps, $2,065; item 7, generators as specified; item 8, waste water pumps; item 9, boiler feed pumps; item 10, sump pumps; item 11, fire pumps, corrected price $81,732; Sec. D; boilers, Burford, Hall & Smith, $54,000; Sec. E, Piping and auxiliary machinery to Burford, Hall & Smith; Secs. F and G; Laying cast iron water pipe to Benj. Thompson, Tampa, Fla., at $38,715 and $21,650; Sec. J: Elevated steel tanks and tower to Chicago Bridge & Iron Works, Healey Bldg., Atlanta, Ga., at $41,150; Sec. K: Radial brk. chimney to Alphons Custodis Chimney Constr. Co., Atlanta, Ga., at $5,945; Sec. L: Waste drain to Benj. Thompson, Tampa, Fla., at $16,340; Secs. M. G. H. & I. Cast iron pipe and spcls. to U. S. Cast Iron Pipe and Foundry Co., Birmingham, Ala., at $202,026; Sec. N: Gate valves, etc., to Iowa Valve Co., Oskaloosa, Ia., at $17,599.

La., Coushatta—McEachin & McEachin, So. Trust Bldg., Little Rock, Ark., awarded contract for water wks. and sewers, at $60,000.

La., Lafayette—City Bd. of Trustees let contracts for machinery and other equipment for repair of water and light plant: Bush-Sulzer Co., at $72,000 for 2 engines and to Westinghouse Elec. & Mfg. Co., East Pitsburgh, Pa., at $18,842 for 2 alternators, 2 excitors, one 13-panel switchbd. and 3 series transformers with panels.

Minn., Rochester—Bland Engrg. Co., L. & Kennedy Sts., N. E., Minneapolis, awarded contract for concrete tank on 90 ft. tower, at $33,100.

Minn., Waconia—Bruce-Bickelhaupt, Des Moines, Iowa, awarded contract for mains and pumping equipment, at $30,216; Chicago Bridge and Iron Works, 608 S. Dearborn Street, Chicago, contract for tank and tower, at $7,000.

N. Y., New York—C. De Blasio, 339 7th Ave., Mt. Vernon, contract for mains in Delafield, Newton and Sedgwick Aves., at $16,685; Barnes, Kingsland and Monticello Aves., at $7,490; Draganetti Constr. Co., 1123 Clinton Ave., contr. for mains in Andrews, Liebig and Netherland Aves., at $8,890; Beaver Eng. and Constr. Co., 57 Chambers St., Chitden and 5th Aves., at $16,100; transferring and re-arranging connections in 10th Ave., Allen and Hudson Sts., at $11,438. Norton Eng. & Contg. Co., 510 W. 149th St., mains in Gildersleeve, Hudson, Ludlow, Olmstead, Pugsley and Waterbury Aves., Barrett, Belton, Purdy and E. 172nd Sts., at $11,300; White Plains Rd. Bryant, Bowler, Gleason, Leland, Noble & Wallace Aves., $8,300; Melrose Constr. Co., 230 E. 162nd, Morris Lane, etc., etc., at $12,828.

N. Y., St. George—Knight & Demicco, Inc., 448 E. Tremont Ave., New York, contract for mains in Austin, Cedar and Carlton Aves., etc., at $27,400.

N. Car., Durham—Haradaw Construction Co., Columbus, Ga., contract at $934,832 for constr. of dam which is part of the $2,000,000 water development project. Contract includes laying necessary pipe, installing check valves, erecting pole line, clearing wood from dam site, grading river rd. and erecting dam and powerhouse. Other contracts let, are as follows: Lynchburg Foundry Co., Lynchburg, Va., at $72,451, for cast iron pipe; Chapman Valve Mfg. Co., Indian Orchard, Mass., at $6,800 for gate valves; Elliott Co., strainers; Builders Iron Foundry Co., 9 Codding St., Providence, R. I., for Venturi meters; Western Electric Co., 463 West St., New York, at $19,737 for line material; Knoxville Iron Co., Knoxville, Tenn., at $5,302 for rein. steel.

N. Dak., Fargo—W. E. Kennedy, Rm. 9, 7 Broadway, Fargo, contract for settling basins and other improvements at $64,675.

Ohio, Toledo—S. L. Cothrel, Jefferson Ave., mains in Water Supply Line, 69, $38,905; 74, $23,405; 80, $17,093; 81, $16,076; to J. L. Skeldon Engrg. Co. Nicholas Bldg., No. 50, $18,388; 73, $5,948.

Pa., Philadelphia—Bureau of Water Works let contract for 16-in. main in Margaret St. Contr. No. 673, to J. J. McHugh, 1617 Race St., at $32,358; 7 soot blowers, contr. 678, to Vulcan Soot Blower Co. 1104 Commonwealth Bldg. at $3,952; 12,220 ft. cast iron laterals, Contr. 684, to McWane Cast Iron Pipe Co., 209 Crozier Bldg., at $25,418; 500 kw. generators, Contr. 685, to General Electric Co., Witherspoon Bldg., at $22,738.

Tenn., Cookeville—Pittsburgh-Des Moines Steel Co., 804 Curry Bldg., Pittsburgh, Pa., awarded contract for furnishing material and constructing water works, at $126,000.

Wash., Bellingham—U. S. Cast Iron Pipe and Foundry Co., Coleman Bldg., Seattle, awarded contract for 3,200 ft. 36-in. and 2,500 lin. ft. 12-in. cast iron pipe and fittings for high line sys. along no. side Whatcom Crk. at $49,050.

Wash., Seattle—L. Romano & Co., contract for water mains 50th Ave., So., at $4,820; C. Cristo-

faro, contract for 29th Ave., N. E., water mains etc., to R. G. Stevenson, at $7,494; N. 61st St., et al water mains to Interstate Const. Co. at $8,904.

Wis., Hurley—J. H. A. Brahtz, 409 Metropolitan Opera House Bldg., St. Paul, to furnish City with water until City is able to purchase waterworks and supply station. Hurley Water Serv. Co., organized to finance plant. Plant to cost $60,000; 50,000 gal. capy. Contr. for water supply station to Layne-Bowler, 37 W. Van Bureu St. Chicago, Ill. Abt. 50% completed.

Wash., Kalama—Cascade Pipe & Flume Co. 3839 W. Florida St. awarded contract for new water system, 5,000 ft. new gravity pipe line, at $75,000.

Wis., Ladysmith—W. D. Morgan, Ladysmith, awarded contract sewer on E. Minor Ave.—3rd St. to Lindoo Ave.; Lindoo Ave. bet. Lindoo and E. 4th; E. 4th to river, 24-in. vit. pipe; sewer and fill and level trench, at $32,466.
Guide—Prospective work.

Prospective Work

ROADS AND STREETS

Alaska, Juneau—Several important highway impvt. projects will be carried out in near future, the largest rd. impvt. being on Richardson Hwy. from Fairbanks to Chitna and Valdez. This work will be done this summer. Large brdg. will be built to displace ferry, and several stretches of road will be graveled. Road into Circle will be a 160-mile northern extension of the Richardson Hwy., 90 miles of which is well under way. Mt. McKinley National Park on Alaska R. R., about 300 miles inland from Seward, will have 25 miles auto hwy. open for travel by Summer of 1925. Bridges will be constructed and prelim. grading work done this summer. Rivers and harbors work this summer will include constr. of breakwater at Wrangel and dredging of the Snake River at Nome. 87-mile narrow gauge railroad over which freight is transported from Nome to Shelton, in Kougarok mining dist., will be reconstructed. Similar road into Tolvana mining dist., now 13 miles in length, will be doubled in length.

Alaska, Skagway—Secy. of Agriculture has approved expendt. of $95,000 to extend present road to connect with old Brackett Rd. Work will start as soon as Bureau of Public Roads can arrange.

Cal., Arcadia—Election about September 1st to vote on $230,000 bond issue for paving City streets.

Cal., Sacramento—Commr. N. T. Edwards of Commission announces that work will start shortly on grading coast hwy.—Balboa Palisades to Laguna Beach. Other work for immediate future includes the 26-mile hwy. across Rindge prop. to Malibu mountains; straightening dangerous turn at Carlsbad. Either ovehead crossing or subway will be built at Ervine.

Cal., Upland—Upland Business Men's Assn. has requested City Council to start proceedings for paving all alleys in bus. district. V. H. Wilson, Pres. of Assn.

Fla., Bartow—Polk County Commissioners Dist. No. 1 plans to improve 2 roads totaling 31 miles; Mulberry-Brewster, through Pierce and Mulberry-Plant City; also construct 2 bridges over north branch of Alafia River, $600,000 bonds voted.

Ia., Dubuque—Council adopts resolution to issue $100,000 bonds to grade Rockdale Rd. Jno Stuber, Clk.

La., Covington—St. Tammany Parish Road Dist. No. 3 plans hard surfacing highway radiating from Abita Sprgs. $150,000 bonds voted.

La., Natchitoches—Natchitoches Parish has voted $1,871,000 bonds for road building. For detailed information address Police Jury.

Miss., Louisville—$120,000 bonds voted here for hard surf. roads in Winston County—Choctaw Co. line to Neshoba Co. line on so.

Mont., Anaconda—Resolution passed for Spcl. Impvt. Dist. 105 for resurfacing with asph. conc. or Warrenite bitulithic wearing surf. 2-in. thick. Est. 17,600 sq. yds. paving, at $1.90 per sq. yd., or total of $34,060, City Clk. F. M. Davidson.

Mont., Helena—Resolutions passed for following: Spcl. Impvt. Dist. 143; Clarke St. Harrison Ave. Holter St., Olive St., Wash. and Hamilton Sts. Est.: ulithic on crushed rock base, $44,500; Warrenite-bitulithic on bitum. conc. base, $44,500. Spcl. Impvt. Dist. 144: Concrete walks, $450. V. N. Kessler, City Clk.

N. C., Asheville—City plans to expend $400,000 to improve streets.

N. C. Windsor—Bertie County plans road bldg.; vote soon on $1,000,000 bonds.

N. D., Ft. Yates—Sioux Co., Hwy. Comn. has decided to constr. 16½ mile rd. no. of Ft. Yates to Cannonball and Solen; 16½ mi. rd. on Selfridge-Solen rd. no. of Selfridge; bridge at Cannonball. F. B. Fiske, Co. Aud.

S. C., Edgefield—Edgefield County Hwy. Commission plans to build and improve about 100 miles local roads. G. H. Ballentine, Secy., Johnston.

Tenn., Maryville—Blount County Court plans to macadamize 28 roads, totaling about 40 miles. Contemplates voting Sept. 24th on $380,000 bonds.

Tenn., Huntingdon—Carroll County plans to build 3 roads as follows: West from Huntingdon to Lemoresville, south to Terry's Bridge, $150,000; north from Huntingdon to Cozirt's store and Liberty Church, then to McKenzie, $100,000; from Huntingdon to Clarksburg then to Henderson Co. line, $100,000. Contemplates $350,000 bond issue.

Texas, Cuero—De Witt Co. plans to improve County's part of McCrory Hwy., Cuero-Westhoff Dist. being portion of National Glacier to Gulf Hwy. $135,000 bonds available. State Hwy. Comn. and Fed. Dept., each to pay equal amt.

Tex., Huntsville—Walker County plans 80 miles conc. and bitum. surfaced roads. Est. cost $2,000,000. Bonds voted. D. K. Caldwell, Engr., Tyler.

Tex., Hillsboro—State Hwy. Dept., Austin, plans rebuilding Colorado-to-Gulf Hwy. from Hillsboro via Itasca to County line. Approx. cost $300,000, County will pay $28,000 of this amt., and State Hwy. the balance.

Tex., Linden—Cass County plans 12 miles high type pavement on State Hwy. No. 8—Douglasville to Linden. Approx. cost $230,000. F. E. Hess, Co. Engr., Medical Arts Bldg., Dallas. S. L. Henderson, Co. Judge.

Tex., Luling—City plans to grade, gravel, etc., 33 miles of streets. Albert Taylor, City Commr.

Tex., Woodville—Tyler County, Woodville, Colmesnell and Warren Districts plan to hard surf. road from Hardin Co. line to Angelina Co. line. Est. cost $450,000. Plans voting on $150,000 bonds. Address Co. Commrs.

Va., Ft. Myers Hts.—Arlington District, Arlington County, plans to build 10 16-ft. concrete roads. Considering $326,000 bond issue. Capt. Jno. T. Talman, Co. Supt. of Rds.

W. Va., Beckley—City plans street paving, $50,000 bonds voted.

SEWERAGE AND SEWAGE TREATMENT

Cal., Compton—City Council has announced intention of calling a $40,000 bond election for sewage disp. plant.

Cal., Fullerton—L. Wayne McCollum, Fullerton, has submitted to Boards of the La Habra and Buena Park sanitary districts 3 propositions for solving sewer problems of these dists. and western sec. of Fullerton. One plan is to run line so. on Magnolia to Ocean Ave. thence to jct. point at Garden Grove. Est. cost $91,000; second plan is for main to start at intersect. Magnolia and Valencia to run along Brookhurst so. to Orangethorpe, thence east to Nicolas, $85,000; the other plan is for line on Valencia to Brookhurst, so. to Orangethorpe, thence to Nicolas. Est. cost $38,000. Pumping plans will be needed under all three plans.

Cal., No. Sacramento—Election may be called to vote on $25,000 to $35,000 bonds for sewerage system. W. O. Irwin, City Clk.

Cal., Oakland—City considering calling election for purpose of voting on bond issue in sum of $1,000,000 for constr. of sewers. W. W. Harmon, City Engr.

Cal., Pasadena—Pasadena Board of Directors

BUYERS' GUIDE

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The Texas Co.
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Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants
Cummer & Son Co., The F. D.
Warren Bros. Co.

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Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Pierce-Arrow Motor Car Co.

Automobiles.
Ford Motor Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
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Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Brick, Paving.
National Paving Brick Mfrs. Assn.

Bridges.
Luten, Daniel B.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping
Littleford Brothers.
Pawling & Harnischfeger

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Gun Work.
Indiana Gunite & Const. Co.

Cement Testing.
Chicago Paving Laboratory.
Flood & Co., Walter H.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Van Trump, Isaac.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chemists, Engineering
Chicago Paving Laboratory.
Dow & Smith.
Flood & Co., Walter H.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Van Trump, Isaac.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Littleford Brothers.

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Pennsylvania Salt Mfg. Co.

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Carey Co., Philip, The.
Rosing, Inc., Astrid S.
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Stewart, W. H.

Consulting Engineers.
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Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Druar & Milinowski.
Flood, Walter H., & Co.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

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Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

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(Factory Floors, Bridge Floors)
Republic Creosoting Co.

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Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

has applied to State Bd. of Health to increase capy. of tri-city sewage disp. works which now serves city, Alhambra and So. Pasadena. A 50 per cent capy. increase is requested.

Cal., Porterville—Dr. O. I. Daley, Health Commissioner, making test of possibilities of using sand filter at sewer farm. If test proves all right the cost of complying with State requirements will be considerably less than anticipated. Constr. of new plant dependent on engineer's report.

Cal., Stockton—$339,800 bonds voted for street and sewer impvts. Mr. Hogan, City Engr.

Cal., Tulare—Elrod Engineering Co., Mills-Fraser Bldg., Santa Monica, has prepared plans for new sewage treat. plant and sewer system to be installed here under new $165,000 bonds. $35,000 of this sum is for sewage treatment plant and balance for sewers.

N. B., East St. John—City Council considering addition to sewerage system to cost $26,000. Plans being prepared by G. G. Murdock, Leinster St., St. John, for sewerage sys. est. to cost $55,000.

Ont., Guelph—City plans 16,500 ft. 9-in. or more, of vit. sewers, etc. Est. cost $65,000. N. S. Nicklin, City Engr.

Ont., Merritton—City considering laying 10,000 to 15,000 ft. 9-in. or more vit. tile sewers at cost of approx. $100,000. R. Clark, City Clk.

Ct., Watertown—City considering constructing sewers in several streets at cost of about $30,000.

Fla., Ft. Pierce—$60,000 bonds voted for san. sewers and $40,000 for storm sewers.

Fla., Kissimmee—$70,000 bonds voted for san. sewers and $26,500 for storm sewers.

Fla., Lake City—$50,000 bonds voted here for sewerage extensions.

Fla., Largo—$35,000 bonds voted here for sewage plant, electrically equipped pumping service for water plant, etc.

Fla., Palatka—$40,000 bonds voted for extension to present system.

Fla., Vero—City will vote Sept. 9th on $25,000 bonds for sewage disposal plant. Carter and Damerow, Engr.-in-Charge; also plans constructing $72,000 sewer pipe line.

La., Bastrop—$125,000 bonds voted by Morehouse Parish for sewerage system.

Md., Baltimore—City plans to vote Nov. 4th on $10,000,000 loans for sewers; also $1,500,000 for electrical conduits.

Mo., Bolivar—City will hold election for purpose of voting on $45,000 sewer bonds.

Mo., Higginsville—Prelim. plans being made for new water wks., distribution sys. and sewers in various sts. Est. cost $90,000. E. T. Archer & Co., 609 New England Bldg., Kansas City, Engrs.

N. Y., Binghamton—Plans prepared for new Trout Brook sewer, Sec. 1. $140,000. Sec. 2, $150,000. E. H. Prentice, City Engr.

N. Y., Binghamton—Plans being made for san. sewers in Park Terrace Pl. McNamara, Milfred and Mitchell Aves; storm water sewers in Conklin and Saratoga Aves., Duke, Montour, Macon, Decatur, Delmar and Medford Sts. Cost will exceed $25,000. E. H. Prentice, City Engr.

N. Y., Lackawanna—Common Council plans additions and impvts., to disposal plant. Est. cost bet. $50,000 and $60,000.

N. C., Wilkesboro—Town will expend $16,000 for 3 miles of 8 and 10-inch terra cotta sewers. Carolina Engineering Co., Engrs., Wilmington, N. C. W. A. Ebert, Contr., Charlotte, N. C.

Okla., Coweta—City will construct san. sewers. May vote on $47,500 bonds. Hughes Engrg. Co., 206 Cole Bldg., Tulsa, Cons. Engrs.

Tex., Corpus Christi—City Council has retained Alexander Potter, 50 Church St., New York City, (Consulting Engineer) to make survey for water and sewer improvements here.

Tex., Houston—City will expend $66,000 for san. sewer on Telephone Rd.—Polk Ave. to Country Club. O. F. Holcombe, Mayor.

Tex., New Braunfels—$60,000 bonds voted here for sewer system impvts.

Texas, Waco—Plans being made for disposal plants, including 2 pumping plants, grit chambers, 8 Imhoff tanks, 4 double sludge tanks, sprinklers, cast iron pipe, vit. pipe, etc. Est. cost $350,000. Terrell Bartlett, Engrs., Calcasieu Bldg., San Antonio, Cons. Engrs.

Va., Strasburg—Election planned to vote on $40,000 bonds for purpose of extending sewers and water mains. Mayor, C. W. Heater.

W. Va., Beckley—$38,000 bonds voted for sewers here.

W. Va., Morgantown—City voted $600,000 bonds for sewer impvts. G. H. Bayles, City Mgr.

Wis., Chippewa Falls—Bids will probably be asked in August for sewers on Vine St.—Main to Edna Sts.; 1,080 ft. 10-in. pipe. O. G. Holway, City Engr., L. J. Felix, City Clk.

Wis., Glenwood City—Plans completed for extension to sewerage system. First Ave. 1,030 ft. 8-in. vit. pipe, 160 ft. 10-in. cast iron pipe, 50 ft. 10-in. vit. pipe, 5 brk. or conc. manholes, septic tank, r. c., 38x12 with conc. top. O. G. Holway, Chippewa Falls, Engr.; Geo. Kobertstein, City Clk.

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WATER SUPPLY AND PURIFICATION

Ala., Selma—City (W. B. Hall) contemplates voting on $150,000 water works bonds.

Ark., Hot Springs—Hot Springs Water Co., 915 Central St.—S. E. Dillon, Gen. Mgr.—plans to expend $75,000 for enlargement of water sys., including erection of storage dam having capy. of 100,000,000 gals.; rebuild high pressure filter wash line, etc. Have applied to City Council for 50-yr. exten. of franchise.

Cal., Pasadena—City has applied to Secy. of Int. for permit to construct large dam and reservoir in San Gabriel Canyon. Est. cost $1,000,000.

Cal., San Bernardino—Local organizations preparing to launch campaign for a $100,000 bond issue for fire protection work, including a 10,000,000-gal. reservoir in Waterman Canyon.

Cal., San Diego—Council has set Sept. 10 as date for $4,475,000 water bond issue election; for main purpose of bldg. dam at Mission Gorge site No. 2. $3,600,000 will be used for Mission Gorge dam, acquisition of flooded lands, pipe line, filter plant; balance for harbor and pier impvts.

Cal., Santa Monica—Elrod Engineering Co., Mills-Fraser Bldg., Santa Monica, completing plans for pump house, sump and pumping machinery for the Sawtelle Blvd., and Charnock Road pumping plant, Santa Monica. Pump house will probably be brick concrete; sump will be rein. conc. and machinery will include deep well and booster pumps—all electrically operated. Mr. Elrod also reports that main office of firm in Dallas, Texas, has been commissioned to appraise water system and adjust water rates for franchise purposes in Paducah, Ky., (50,000 population).

Ont., Port Arthur—Public Utilties Commission here contemplates location of permanent distribution station with complete machinery and equipt., at Bear Point, in connection with hydro-elec. development at Cameron Falls.

Que., Three Rivers—Asselin & Denoncourt, 42 Alexandre St., will prepare plans for $370,000 filtration plant. Chas. Gelinas, Engr. Art. Surveyor & Co., Cons. Engrs., Montreal.

Que., Valleyfield—City plans 2-bed filtration plant (rapid type) . Est. cost abt. $90,000. Y. Sullivan, Town Engr.

B. C., Vancouver—Detailed plans almost ready for the two submerged dams which Water Works Dept. plans to have constructed by Day Labor. Est. cost of each dam $10,000. Work may begin early next month.

Ont., Ft. William—Bids will soon be received for 18,000 ft. 24-in. cast iron mains. Est. cost $125,000. C. B. Symes, City Engr.

Ont., Oakville—Town plans 20,000 ft. 6-in. cast

BUYERS' GUIDE

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Dee Clay Mfg. Co., W. E.
Rosing, Inc., Astrid S.

Dryers.
Cummer & Son, The F. D.

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Dump Wagons.
Austin-Western Road Machinery Co.

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Dynamite.
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Truscon Steel Co.

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Electrical Wires & Cables.
American Steel & Wire Co.

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Austin-Western Road Machinery Co.

Excavating Machinery.
Austin Machinery Corp.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co., Inc.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
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Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Gates, Sluice.
Coldwell-Wilcox Co.

Graders.
Austin-Western Road Machinery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gunite.
Indiana Gunite & Const. Co.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Mead-Morrison Mfg. Co.

Hot Mixers.
Austin Machinery Corp.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
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Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

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Motor Trucks.
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Federal Motor Truck Co.
Ford Motor Co.
International Motor Co.
Kissel Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers, and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Murpysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Strickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
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Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

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iron mains, hydrants, valves, etc. Approx. cost $80,000. R. Smith, City Engr.

Fla., Miami—Water Company contemplates installing cross city main of abt. 2 ft. in diam. to serve as booster main for no. and so. city main; also to supply water for Miami Beach. H. H. Hyman, Gen. Mgr.

Fla., Pensacola—Government considering expending $150,000 for water supply for naval air station.

Ga., Dawson—$40,000 bonds voted here for installing water mains.

Ia., Marion—Marion Water Company will build water tower; probably steel. R. C. Toms, Mgr.

Ia., Tama—Will vote on bonds for water works system, D. A. Murdough, City Clk.; Chas. L. Pillsbury Co., 1200 2nd Ave., S. Minneapolis, Cons. Engrs. Est. cost $40,000.

Ky., Ashland—City (E. C. Means, Chrmn. of Water Comn.) contemplates voting on $300,000 bonds for extension of water system.

Md., Baltimore—V. Bernard Siems, Water Engr. submitted plans for constr. of $2,000,000 water reservoir to Pub. Impvt. Comn. for project to be financed out of $10,000,000 remaining of water loan; proposed reservoir would have capy. of 22,000,000,000 gals. water; would be built in valley of stream in no. part of Baltimore Co. and connected with Gunpowder River.

Md., Baltimore—Pub. Impvt. Commission appropriated $142,000 for extension of water mains on Harford Rd., $80,000 for extending water mains on Rogers Ave., and $37,889 for extension water mains on Roland Ave.—Univ. Parkway to Linwood Ave.

Minn., St. Cloud—Prelim. plans made for water works system. Maturity indefinite. Engrs. Chas. L. Pillsbury Co., 1200 2nd Ave. S., Minneapolis. A. W. Buckman, City Clk.

Minn., Winona—Council authorized purchase of site for 2,000,000 gal. reservoir. Now sinking artesian well. Will start work on reservoir in Fall. Geo. W. Hoffman, City Clk.

Miss., Crystal Springs—City will soon call for bids for constr. of 100,000 gal. concrete reservoir at power plant.

Miss., Vicksburg—City Water Works (M. L. Worrell, Bowmar Ave., Engr.-Mgr.) will construct pipe line from City's northern boundary to Waltersville, a small manufacturing community 2 miles distant; will use about 11,000 ft. 8-in. cast iron pipe with valves and specials. Work will be done by Company's forces.

Mo., Burlington Jct.—$42,000 water works bonds voted here.

Mo., Charles City—City plans to vote on $50,000 bonds for water mains and sewer extensions. For detailed information address the Mayor.

Mo., Washington—City voted $65,000 bonds for water tower and water main extension.

Neb., Scottsbluff—Commission appointed to investigate water supply system. Will probably sink new wells. City Clk. J. W. Bly.

N. C., Southern Pines—City voted $150,000 water bonds and $40,000 sewer bonds.

Okla., Durant—City contemplates voting on $100,000 water bonds. Stanley Williams, Atty.

S. Car., Landrum—$100,000 bonds voted for installing water and sewer system.

Tex., Fort Worth—City (Geo. C. Clarke, Park Supt.) has under consideration the erection of a 300,000-gal. reservoir near Forest Park swimming pool to supply water for the pool.

Tex., Mercedes—Dr. Malone Guggan, State Health Officer, interested in plan to establish water purification plant to supply water for Mercedes, Mission, San Benito, Harlingen, McAllen, Donna, Pharr, Llano, Grant, La. Feria, etc.

Tex., San Antonio—Plans being made for mains and laterals in Peach St.—Goliad St. to river—at cost of $90,000; Highland Park—Highland Pk. to creek at Presa and School Sts., $90,000; Arrita and San Pedro Sts., to San Pedro Crk., $45,000; S. Medina St.—Commerce to Vera Cruz Sts., $30,000; Ave. D to San Antonio River, $25,000. I. Ewig, City Engr.

Wash., Port Angeles—Matter of installing water system being considered; water to be taken from Morse Crk.

Wash., Seattle—City Council Utilities Commission has appropriated expenditure of $1,750,000 for city water system extensions. City Engr. J. D. Blackwell instructed to prepare plans for pipe line and 3 reservoirs. Plans call for construction of reservoir near southern city limits at Leo St. and a 48-in. pipe line to tap main Swan Lake line and extend to West Seattle where 2 reservoirs would be built. Est. cost of reservoirs, approx. $900,000, and pipe line, $542,000. Other incidentals will bring total cost to $1,750,000.

Wash., Snohomish—City Engr. E. W. Klein was recently instructed by City Council to prepare Ord. of intention for emergency impvts. to City water system which would call for expendt. of $21,000. New reservoir and additional water mains was suggested by Council.

Wis., Eau Claire—Ordinance passed providing for $165,000 water works impvt. bond issue.

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Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

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Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.

Rock Asphalt.
Kentucky Rock Asphalt Co.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Scarifiers.
Austin-Western Road Machinery Co., The

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The

Scrapers, Power.
Sauerman Bros.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Clay Products Assn.
Dee Clay Mfg. Co., W. E.
Rosing, Inc., Astrid S.

Sewer Pipe Joint Compound.
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
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The Barrett Co.

Tarvia.
The Barrett Co.

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Walter H. Flood.
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"If Michael Angelo built roads,"

Says the King of the Black Tops,

"I know they would be masterpieces—work of genius and patience—of the spirit which governs our laboratory staff and our engineers.

Warrenite-Bitulithic PAVEMENT

is the perfected product of patient study, careful research and attention to the multitude of details that go to make perfection. This great work—behind the scenes—is the secret of pavement performance that has challenged comparison for years."

May we send you our booklets that show some work "behind the scenes?"

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Highway Construction Equipment Service

If in the market for any of the following highway construction equipment, so indicate by check marks, mail this page to ***Municipal and County Engineering,*** 702 Wulsin Building, Indianapolis, and price quotations and descriptive literature will be forwarded to you.

—Air Compressors
—Asphalt Plant, Portable
—Asphalt Plant, Railroad
—Asphalt Tools
—Asphalt Tool Wagon
—Bar Cutters and Benders
—Bars, Reinforcing
—Bins, Portable Stone
—Bodies, Dump Truck
—Brick Rattlers
—Catch Basin Covers
—Cement Testing Machinery
—Clam Shell Buckets
—Contraction Joint
—Cranes, Locomotive
—Crushers, Stone
—Drag Scrapers
—Dragline Cableway Excavator
—Dump Cars
—Dump Wagons
—Excavator, Crane
—Elevating Graders
—Gasoline Locomotives
—Gravel Screener
—Heaters, Asphalt
—Heaters, Tar
—Hoisting Engines
—Industrial Cars
—Industrial Track
—Manhole Covers
—Mixers, Building
—Mixers, Hot
—Mixers, Paving
—Motor Trucks (1-3 tons)
—Motor Trucks (over 3 tons)
—Oil Distributors
—Portable Conveyor
—Portable Drilling Rigs
—Pile Drivers
—Pumps
—Reinforcing Steel
—Road Drags
—Road Forms
—Road Graders
—Road Mesh
—Road Planes
—Road Plows
—Road Rollers
—Road Scrapers
—Sand Dryers
—Saw Rigs
—Scarifiers
—Scrapers, Power
—Sheet Piling, Steel
—Skimmer, Scoop
—Steam Shovels
—Stone Elevators
—Stone Screens
—Stone Spreaders
—Surface Heaters
—Tampers, Road
—Tractors
—Trailers
—Turntables
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—Wagon Loader
—Wheeled Scrapers
—Wire Mesh

"That Brick Was Laid in 1894—

We can't ask a better investment than that!"

THERE are numerous towns and cities in which the citizens can point with satisfaction to *brick-paved* streets laid away back in 1894 or earlier.

For instance, Springfield, Ill., has a brick pavement still in service which was laid in 1889—35 years ago. Lincoln, Nebr., uses a 34-year old veteran. Taxpayers in Clearfield, Pa., and Bucyrus, Ohio, profit by 33-year old brick pavements. Lynchburg, Va., points to 32-year old brick surfaces in good condition in spite of heavy, modern traffic—so do Winona, Minn., and Clinton, Iowa.

Tonawanda, N. Y., has several brick-paved streets with 31 years of faithful service to their credit—and so has Cleveland, O., though some of them were laid on the natural soil without any other base or support.

And among those using 30-year old pavements are Joliet, Danville, Carlinville, and East St. Louis, Ill., Meridan, Miss., and Williamsport, Pa.,—to mention just a few out of a long list.

See to it that your community buys *today*—pavements that will still be in service in 1954.

• • •

VITRIFIED Brick PAVEMENTS

Advocate vitrified brick—*the pavement that outlasts the bonds.*

OUTLAST THE BONDS

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION, ENGINEERS BLDG., CLEVELAND, OHIO

Water Works Equipment Service

If in the market for any of the following water works equipment, so indicate by check marks, mail this page to ***Municipal and County Engineering,*** 702 Wulsin Building, Indianapolis, and price quotations and descriptive literature will be forwarded to you.

—Air Compressors
—Air Lift Pumps
—Ash Handling Mach'y
—Backfillers
—Brass Goods
—Chimneys
—Chloride of Lime
—Chlorinators
—Coal Handling Machinery
—Concrete Hoisting Equipment
—Concrete Tanks
—Condensers
—Conduit Rods
—Cranes, Locomotive
—Cranes, Traveling
—Curb Boxes
—Curb Cocks
—Derricks, Pipe Laying
—Derricks, Steel Portable
—Drinking Fountains
—Dry Feed Chemical Apparatus
—Engines, High Duty
—Engines, Gas
—Engines, Oil
—Engines, Pumping
—Explosives
—Fence, Iron
—Fittings, Wrought
—Filter Equipment
—Gates, Sluice
—Gauges, Recording
—Gauges, Steam
—Gauges, Water
—Goose Necks
—Hydrants, Fire
—Indicator Posts
—Lead
—Leadite
—Lead Furnaces
—Lead Wool
—Leak Indicators
—Liquid Chlorine
—Lime
—Meter Boxes
—Meter Couplings
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—Motor Trucks
—Motors, Electric
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—Pipe, Cast Iron
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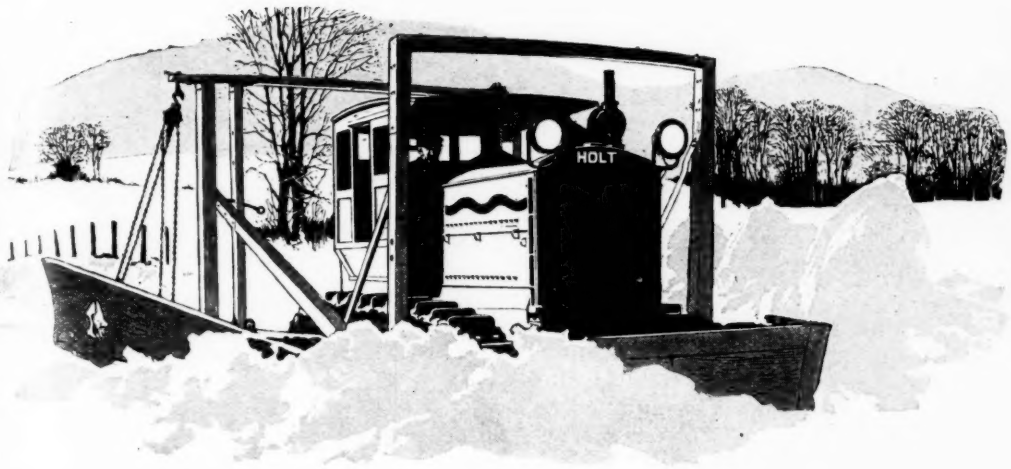
—Water Main Cleaners
—Water Meters
—Water Softening Plants
—Welding Apparatus
—Well Drills
—Well Screens
—Well Strainers



Keeping Winter Roads Open

You realize how serious the food situation, how great the fire risks, how extensive the business losses when a city is crippled by snow. Hundreds of municipalities have found the answer—"Caterpillar" Tractors for snow removal.

Is your city prepared? Right now is the time to insure the safety and health of your community against next winter's snow blockades. New York has 50 "Caterpillars;" and congested business streets are quickly cleared by these powerful snow fighting machines. Lincoln, Nebraska, with 5-Tons; Harrison, N. Y., with 2-Tons; Sheboygan, Wisconsin, with a 10-Ton; are typical of the many cities in the northern states which have found the "Caterpillar" the most dependable and effective power for snow removal work, as well as for road making and maintenance throughout the year.

Investigate now what "Caterpillar" Tractors have accomplished and saved for many northern cities, counties and townships. We can give you convincing facts and figures on the "Caterpillar" for snow removal and public works of every kind.

Write us today.

"THE NATION'S ROADMAKER"

There is but one "Caterpillar"—Holt builds it.

THE HOLT MANUFACTURING COMPANY, *Inc.*

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CATERPILLAR

Reg. U.S. Pat. Off.

When you hear Long Island's Roads Discussed

Think of

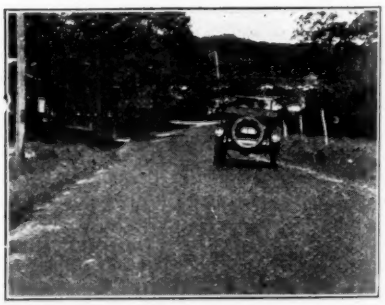
Today you will hear road builders everywhere discussing the "oiled roads of Long Island." You will hear them speak of the splendid results which Long Island has obtained by using Asphalt Road Oil on various types of highways.

When you hear such discussion, think of TEXACO.

TEXACO Road Oil has been serving Long Island for several years on shell, sand-clay, earth, dirt, and old macadam roads; it has helped to build up a system of highway surfaces that is second to none. TEXACO Road Oil's binding, adhesive, dustlaying qualities have been of invaluable service on Long Island.

Call on any office of The Texas Company, Asphalt Sales Department, for information on how Long Island has used Texaco Road Oil to such advantage.

View of the Texaco oiled road at the National Golf Links, Long Island, N. Y.



Stretch of another of Long Island's smooth, easy riding Texaco oiled surfaces.

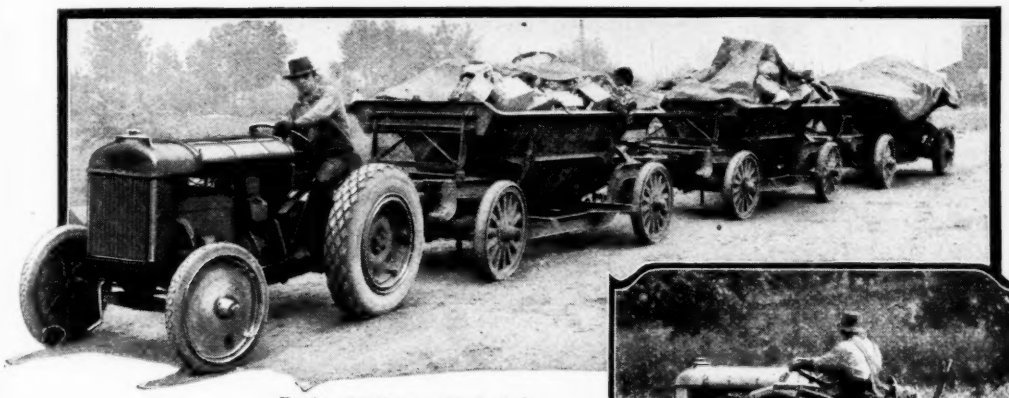
TEXACO

THE TEXAS COMPANY, U.S.A.

Asphalt Sales Department

17 Battery Place, New York City

New York, Philadelphia, Richmond, Boston, Jacksonville, New Orleans, Memphis, Chicago, Cleveland, Oklahoma City, Kansas City, Houston, Dallas, Minneapolis, St. Louis



Fordson hauling trailers loaded with rubbish, street sweepings, etc. Louisville, Ky.

Making Department Budgets Go Farther

These photographs are but an inkling of the many municipal power jobs done better, quicker and at lower cost with the Fordson.

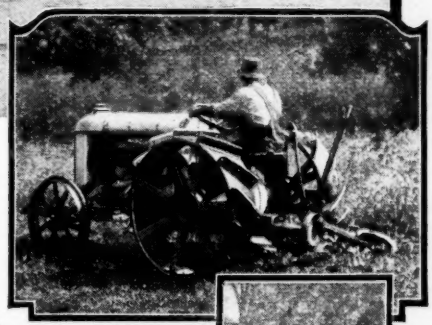
The Fordson is the power plant of a thousand and one uses. It furnishes the power for road building, heavy hauling, excavating, street sweeping and sprinkling, garbage collection and disposal, lawn mowing, wood sawing, cable pulling, water pumping—in fact for every kind of municipal work. Department budgets *go farther* and *accomplish more* with Fordson on the job.

Now is the time to ask your nearest authorized Ford dealer for a practical Fordson demonstration. Experience qualifies him to render you a valuable service.

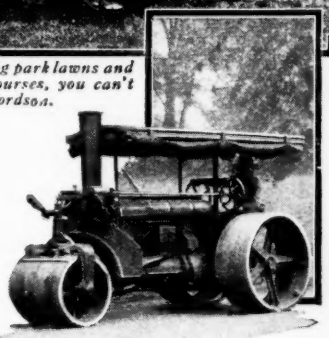
Fordson Tractor $495 f. o. b. Detroit

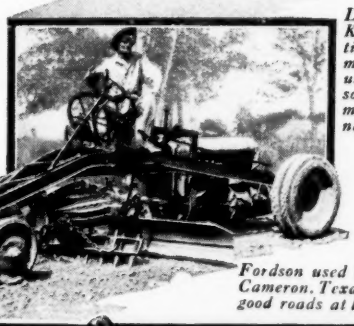
Ford

CARS - TRUCKS - TRACTORS



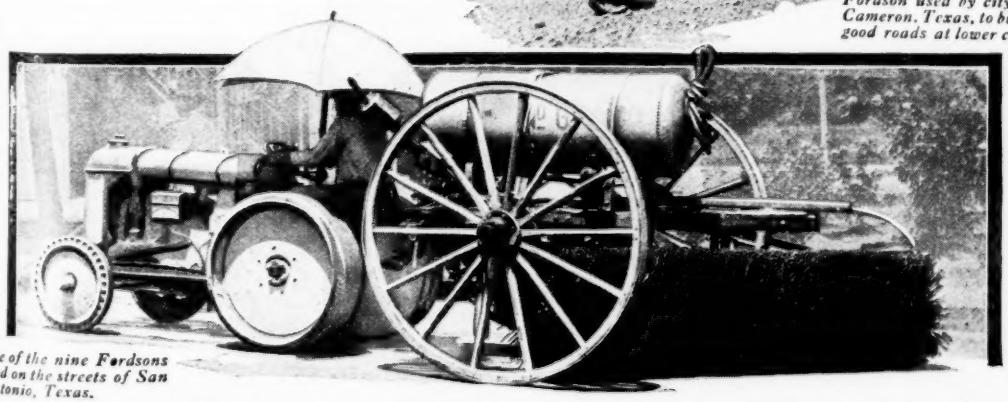
For mowing park lawns and city golf courses, you can't beat the Fordson.



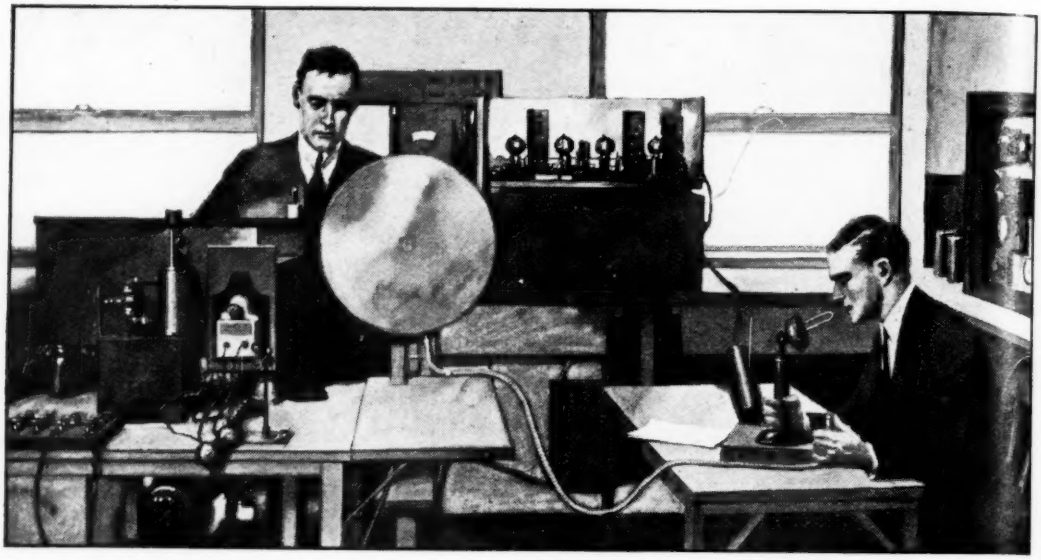


Louisville, Ky., saves time and money by using Fordson for road maintenance work.

Fordson used by city of Cameron, Texas, to build good roads at lower cost.



One of the nine Fordsons used on the streets of San Antonio, Texas.



In the Bell System laboratories speech sounds are recorded on the oscillograph with a view to their subsequent analysis

The service of knowledge

The youthful Alexander Graham Bell, in 1875, was explaining one of his experiments to the American scientist, Joseph Henry. He expressed the belief that he did not have the necessary electrical knowledge to develop it.

"Get it," was the laconic advice.

During this search for knowledge came the discovery that was to be of such incalculable value to mankind.

The search for knowledge in whatever field it might lie has made possible America's supremacy in the art of the telephone.

Many times, in making a national telephone service a reality, this centralized search for knowledge has overcome engineering difficulties and removed scientific limitations that threatened to hamper the development of speech transmission. It is still making available for all the Bell companies inventions and improvements in every type of telephone mechanism.

This service of the parent company to its associates, as well as the advice and assistance given in operating, financial and legal matters, enables each company in the Bell System to render a telephone service infinitely cheaper and better than it could as an unrelated local unit.

This service of the parent company has saved hundreds of millions of dollars in first cost of Bell System telephone plant and tens of millions in annual operating expense—of which the public is enjoying the benefits.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

One Policy, One System, Universal Service

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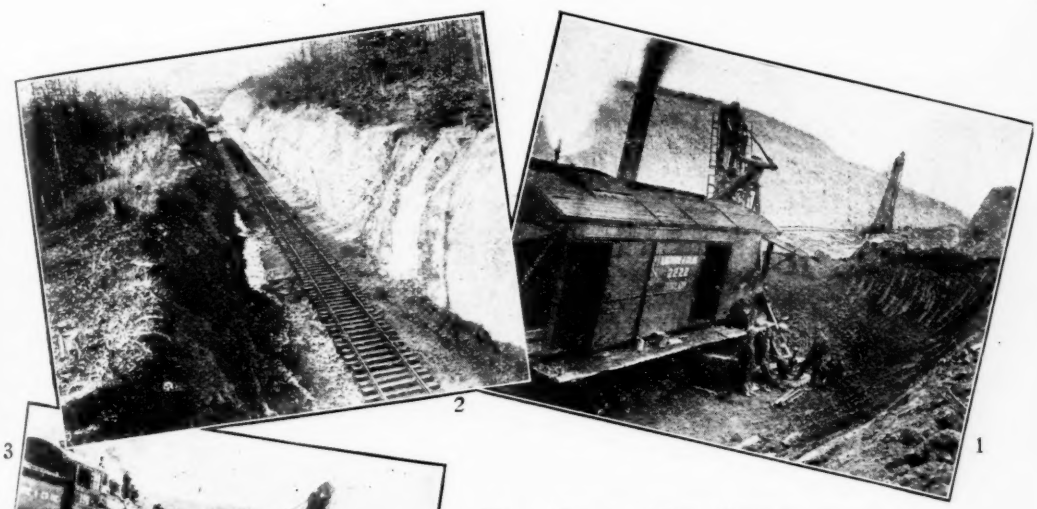

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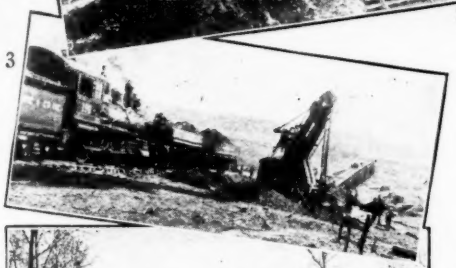

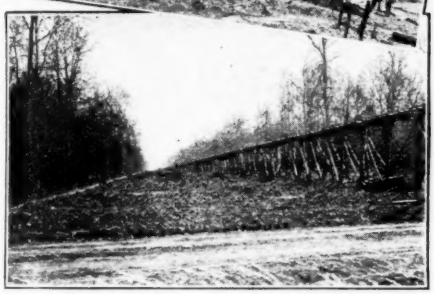

4

1. *One of the 17 steam shovels employed on the job.*
2. *Section of track laid at western end of new construction Illinois Central Railroad.*
3. *Part of the "standard gauge" outfit—three 60-ton locomotives and thirty 72-yard Western air-dump cars.*
4. *One section of the dump trestle extending across the Pond River bottom.*

Du Pont Explosives Used to Build New Railroad into Kentucky Coal Field

IN the construction of a second main line of the Illinois Central Railroad connecting Central City and Dawson Springs, Ky., the use of du Pont explosives, under the capable direction of the construction engineers, ensured the completion of the contract according to its specifications.

Over 2,000,000 cubic yards of sand-rock of varying degrees of hardness were blasted with du Pont gelatin —an explosive not affected by the excessive rains prevalent during a greater portion of the construction period.

An equipment of 17 steam shovels loaded the shattered rock into trains of dump-cars drawn by 60-ton locomotives—a man-size job to keep these busy!

This construction work was under the supervision of Mr. T. H. Robertson, assistant engineer of the Illinois Central Railroad, and Mr. E. H. Brunt'ett, superintending the contract awarded to A. Guthrie & Co., of St. Paul.

"*Time* is the essence of this contract"— and by the selection and use of du Pont explosives and the employment of skilled labor and modern equipment the Guthrie Company acquires and executes such projects as that of the Illinois Central Railroad.

E. I. DU PONT DE NEMOURS & CO., Inc.

Explosives Department

WILMINGTON, DELAWARE

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Springfield . . Ill.
Du Pont Products Exhibit,
Atlantic City . N. J.

DU PONT EXPLOSIVES

An Opportunity for Service

that the public will reward

A NEW development enables you to give your public 50% more light on its streets without extra cost. The people cannot help but see and appreciate so radical an improvement and to applaud the official who is responsible for it.

Holophane, for over thirty years the recognized leader in scientific street lighting, has just introduced a new type of street lighting unit which directs the light in only two or four directions, eliminating practically all waste of light outside of the street area.

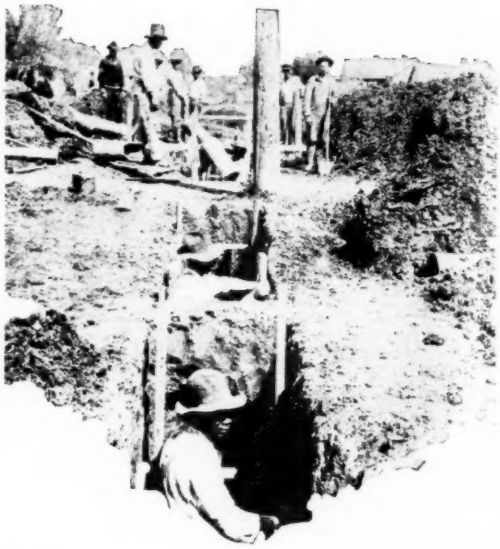
HOLOPHANE GLASS COMPANY, Inc.
346 Madison Ave. New York City

Works: **Newark, Ohio**
In Canada: **146 King St., W., Toronto**

Our booklet "4-Way and 2-Way Refractors" tells how this new development can be applied to your city. A copy will be sent free on request.

HOLOPHANE

DIRECTS LIGHT SCIENTIFICALLY



Ever notice this about clay pipe?

ONCE in a while when a new cross street goes in the men chance onto an old Vitrified Clay Pipe line.

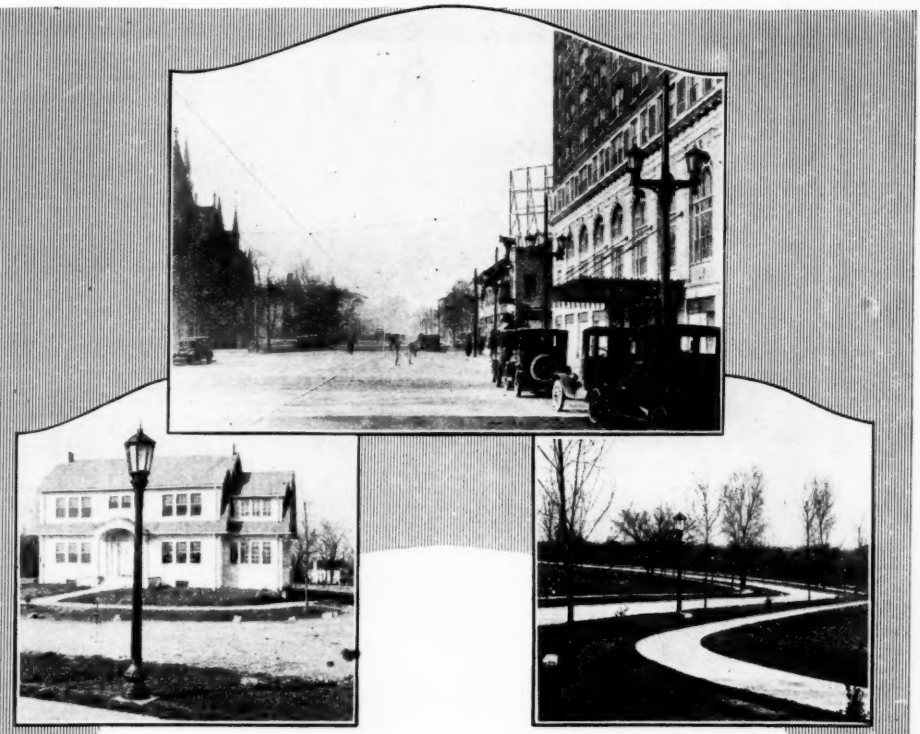
Did you ever stop and examine that old stuff? Shiny and smooth, like the day it was put in, wasn't it? No pits and holes, no indications of the insidious action of ground chemicals, sewer acids and electrolysis, were there? If you'd taken out one of those sections and washed it up, it would be hard to tell it from a new one.

Vitrified Salt Glazed Clay Pipe lasts simply because there is nothing in it that can possibly wear out. Specify Vitrified Salt Glazed Clay Sewer Pipe for permanence.

Clay Products Association
Chamber of Commerce Bldg.
Chicago

VITRIFIED Salt Glazed CLAY
Sanitary Sewer Pipe

MCE-9F-RTG



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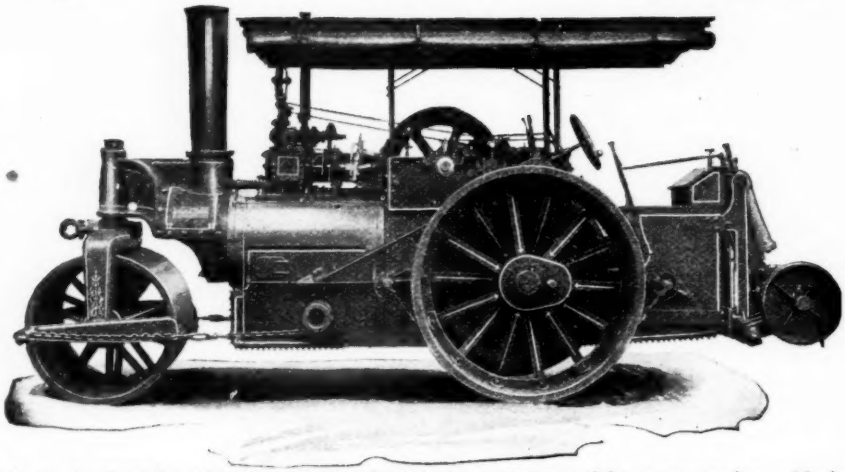

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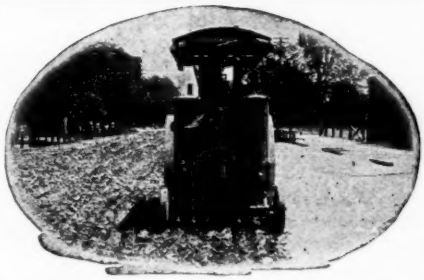

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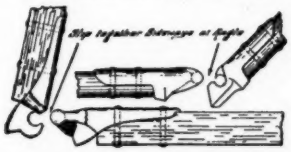

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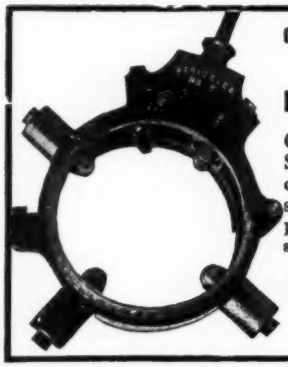

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EDITORIAL

BUS AND RAIL COMPETITION

The New York Public Service Commission recently contributed something of value to the opinion that is being formed with respect to competition between bus lines and rail lines. In a decision, Commissioner Harkness said:

"Disregarding any pretexts for the change of route and various irrelevant considerations that have been presented, the real question here is whether. in this case, the Commission should permit competition between the bus and railway lines by granting a certificate of convenience and necessity. The rule almost universally applied by regulatory commissions is that where there is a utility rendering service, with an investment represented by structure and equipment, a new competing line will not be allowed to come into the field and cut down the earnings of the existing utility and jeopardize its investment. That is the general rule. but its application must be governed by the consideration of these factors: (1) Is the additional service necessary, and (2) Will the competition be ruinous?"

The Wall Street Journal, commenting on this opinion, adds the following thought: "The existing traction companies are in the best position to operate buses for the reason that they are able to offer transfers to existing lines at a nominal fare."

The opinion of the Commissioner, as quoted, interests us chiefly for its frank statement that it has been the policy of such Commissions to check competition between bus and rail lines merely to protect the money invested in the rail lines. That is an important admission, as all should note. In previous editorials we have attempted to show that this position is unsound and untenable. The Commissioner seems on the verge of recognizing that the Commission owes a duty to the public that may transcend its duty to the investor in the rail line. We infer this from what he says about the "application of the general rule." He is making progress.

There is only one intellectually honest basis on which the investment in a rail line can be protected against highway transportation, and that is just plain human sympathy. We are all sorry to see the dollar lost that has been invested in a rail line, or anything else, but this feeling has never been permitted to dictate the final policy that is to govern in the premises. The dollar invested in a rail line is not sacrosanct. Invested dollars are being lost every day in a thousand lines of human endeavor and there can be no permanent check to progress, even if progress renders obsolete that which has been useful. It may be possible for a while to retard the development of transportation for hire on the public highways by making a show of judicial opinions and by parading the philosophy of the private investor in a public utility, but in the end all will perceive that service to the public is the one factor deserving consideration. If the electric rail lines can not stand competition from highway transportation, then the rail lines will have to quit. That is the blunt truth of the matter. But if they can survive by giving the kind, or kinds, of service the public is willing to pay for, everybody will rejoice with them. The owners and managers of these lines should realize, however, that they can not travel much further on sympathy and spurious argument. They must "hit the ball or go back to the bushes." Such is the law of life and appeals from this law are unavailing.

That many electric railway men, who were in hot water a good deal of the time before the first motor bus was built, now see that the bus is more likely to prove their salvation than their ruination is well known. Many electric railways, both urban and interurban, have taken up bus transportation energetically. Others have not. Some are of the irreconcilable, bitter-ender type and persist in refusing to see the way out of their troubles. They will not take up bus transportation themselves and they will not let others do so if they can prevent it. They maintain that bus transportation is a fad and will soon lose its popular appeal. If these men persist in ignoring all warning signs and all friendly counsel and keep on heading toward

the abyss they must accept the responsibility for the unhappy consequences that are certain to follow.

The courts and commissions must speed up the process of liberalizing their opinions on this subject or forfeit a measure of public confidence. We expect our courts to protect property rights but not at the expense of strangling progress.

SUPER-POWER AND DECENTRALIZATION OF POPULATION

The article published in this issue entitled: Super-Power and Its Relation to Progress and Prosperity, emphasizes the belief that the introduction of super-power will tend to decentralize our industries and so spread out the population more uniformly than is now the case. Super-power will distribute industrial opportunity over an ever widening field. This will broaden the scope of industry also. The article states that super-power "tends to distribute the population and to make all parts of the country prosperous, instead of concentrating all industries requiring power into congested areas."

This possibility has a bearing on many of the problems that have been pressing for solution. For years men have been asking whether or not the great cities are either necessary or desirable. It has been, and still is, necessary to answer this question in the affirmative. Perhaps it must always be so answered. Still many have found that it pays to get out of the congested value district of a big city and even to get out of such cities entirely. Only a few have made this discovery. Congestion increases and we find the people of the great cities going to and from work through holes in the ground and on elevated railways. Some cities are discussing multiple level roadways and sidewalks. More and more the dwellers in great cities are taking on the ways of the ant and the bee. There is much rebellion against this almost intolerable crowding which interferes so seriously with many normal human desires.

Maybe super-power shows the way out. Maybe as great city plants depreciate and become obsolescent new locations will be sought and found "far from the madding crowd's ignoble strife." Perhaps we shall find our states becoming more symmetrically developed with many important cities of moderate size and with industries spread out over wide areas. If this comes about there will be a return to the older comforts of life without the loss of any of the newer ones. There will be a great improvement in living conditions without an increase in living costs.

GOOD PRACTICE IN STREET LIGHTING

An article of unusual value on street lighting appears in this issue under the title of: A Study of Street Lighting Systems with Recommendations. This article will be very helpful to municipal engineers and officials who are charged with the responsibility of deciding on the amount of illumination to provide and of selecting the equipment to produce that illumination.

The article is the full text of a report of a joint committee made up of representatives of the New York State Conference of Mayors and Other City Officials and of the Empire State Gas and Electric Association. Thus the viewpoints of both the public official and the utility manager were merged in producing what, in effect, is a manual of recommended street lighting practice. The committee also had the benefit of the advice and cooperation of a street lighting specialist drawn from the ranks of men who are rendering great public service by carrying forward towards perfection the equipment used in modern street lighting. Thus the report is presented from the composite viewpoint of all interested parties and is of undoubted value to engineers and officials.

While the reader will naturally want to read the full article, we give here its principal conclusions, in condensed form. Comprehensive street lighting plans and programs are recommended. It is recommended that lighting in excess of the amount specified be assessed against abutting property, and that such assessments be made on a curb-foot basis and not on the basis of property valuation. The use of lamps giving not less than 1,000 lumens is recommended. The height of the light source should be not less than 10 ft. for small units or more than 25 ft. for large units. On all wide streets the light sources should be placed on both sides of the street. Minimum standards for street lighting in the various districts of cities of various sizes are suggested.

A STUDY OF STREET LIGHTING SYSTEMS WITH RECOMMENDATIONS

(Editor's Note: Following is the full text of the report of the Joint Committee on Street Lighting of the New York State Conference of Mayors and Other City Officials and The Empire State Gas & Electric Association as presented on June 3, 1924. The committee was created to study street lighting systems for cities and especially to work for the development of more efficient methods of street lighting. The New York State Conference of Mayors and Other City Officials originated this joint study and named the following members of the committee: Edwin A. Fisher, consulting engineer to the City of Rochester; Rich D. Whitney, consulting engineer to the City of Syracuse; and M. P. Capes, secretary of the conference and also of the joint committee. The Empire State Gas & Electric Association appointed as its representatives on the committee, Col. C. F. Lacombe, of the Brooklyn Edison Co., Walter C. Pearce, of the Syracuse Lighting Co., Inc., and C. H. B. Chapin, secretary of the association. Mr. A. B. O'Day, street lighting specialist of the Edison Lamp Works, Harrison, New Jersey, was agreed upon as a member of the committee.)

Summary of Conclusions

1. That each municipality adopt a street lighting plan and program for the entire city, to be followed in all new installations or changes in old installations.

2. That lighting in excess of the amount specified in program be assessed against abutting property owners.

3. That assessments for special lighting be made on a curb foot basis and not on the basis of property valuation.

4. That lamps without reflecting, refracting, or diffusing auxiliaries should never be used.

5. That no lamp of less than 1,000 lumens should be used for street lighting.

6. That the height of light source be not less than 10 ft. for small units or more than 25 ft. for large units.

7. That on all wide streets the light sources should be placed on both sides of the street.

8. That minimum standards for street lighting be as shown in the accompanying tabulation.

Present Lighting Not Properly Distributed

An analysis of data collected on present street lighting conditions in New York State indicates that there is inequitable distribution of street lighting as between the various classes of streets. Some streets of many cities appear to be underlighted while in the same cities other streets may have an undue proportion of the available funds expended for their illumination. For example, one city has 245 lumens per foot in the retail business section and 7 lumens per foot for its main automobile highway. Obviously, the latter street is not getting its fair share of illumination.

Comparisons Frequently Misleading

Any quantity of statistics as to cost and energy consumed per capita or per mile of street, etc., could be given. There are, however, so many variable factors that statistics of this character or comparisons of figures relating to one community with those relating to another are valueless without the most detailed analysis. It is interesting, however, in this connection to learn that in this State, outside the city of New York, the amount of electricity used in street lighting; that is, the number of kilowatt hours, has not increased to any extent since 1914. This does not mean that the lighting of the streets has not improved. It means, rather, that the efficiency of the light-giving units has greatly increased.

Benefits of Good Street Lighting

Cities and towns of the United States,

MINIMUM STANDARDS FOR STREET LIGHTING

	Minimum Lumens per Lineal Foot	Maximum Spacing along Center Line of Street
Business Section—Population over 100,000	200	125
Business Section—Population 50,000 to 100,000	120	125
Business Section—Population 20,000 to 50,000	80	125
Business Section—Population up to 20,000	60	125
Main thoroughfare—Fully developed residence district	35	150
Fully developed residence district	15	250
Outlying residence districts	10	250

Note 1.—The standard street is taken as being 40 feet from curb to curb. For streets of greater width, the values of minimum lumens per linear foot should be increased in the same ratio as the width of street.

Note 2.—Where secondary business districts adjoin main business districts, the equipment should be of similar design, but the illumination of approximately one-half the lumens per linear foot, as the latter.

when first settled, gave very little attention, if any, to the question of city growth and development. When developments did come along, the cities instead of expanding scientifically, and in some well-planned manner, broke loose, so to speak, and simply "grew up." These remarkable strides in growth have occurred within very recent times. In taking care of the increase in population, city officials simply made arrangements for the very essentials in comfort; that is, sewers, paved streets, sidewalks and the like—but paid relatively little attention to the lighting.

Now that municipalities have developed a civic consciousness, we find a stimulus for adequate street lighting. This movement is not a fad, it is simply the result of a long, neglected want. Today, we find cities and towns everywhere realizing the benefits of good street lighting. Some of these benefits are tangible and others are not.

We find that crimes and accidents are reduced, congestion of traffic relieved, industries are attracted, the sanitary conditions of the streets are bettered, civic pride is given expression, and there is a psychological impression of thrift and progress.

Trend of Street Lighting Practice

The trend of modern street lighting practice is very definitely toward the use of more attractive installations and large light sources. Ornamental poles are used because they are an adornment, they give expression to the aesthetic sense of the community, and they can be utilized in some cases to reduce overhead wires and unsightly wooden poles. Large light sources are used because they are more efficient than the smaller sizes; that is, they give more light per unit of power used.

Adoption of Street Lighting Program

As a result of the above analysis the committee recommends that each municipality adopt a program for adequate and efficient lighting, specifying for each type of street the number of lumens in light source, the height of light source above the pavement, the type of standard fixtures, and the spacing along the center line of the street.

The streets of the city, block by block if necessary, should then be classified so that in all new installations or changes in old installations the program adopted can be applied. It is of the utmost importance in order to secure good lighting attractive in appearance and adequate in quantity, that the cities abandon the hit or miss method now in more or less common use under which lights are installed.

Assessment for Special Lighting

The committee, also, recommends that after the adoption of such program, if additional lighting is desired by property owners on any street, such additional lighting should conform with the type and standard established, and be approved by the proper municipal authority. Any cost in excess of the cost of the lighting specified in the program of such street should be assessed by the municipality against the abutting property owners. This assessment should be made on a curb foot basis and not on property valuation. If necessary to carry out the last recommendation, local legislation should at once be enacted.

Unit of Measurement

Before lighting of any kind can be considered intelligently, some notion of the means of measuring the strength of light sources and the quantity and strength of light which falls on the surfaces desired to be illuminated, must be had.

The term "candle power" is, no doubt, familiar to us all and is usually thought of as the strength of source of the ordinary paraffin candle some three-quarters of an inch in diameter. In order that a more adequate notion of a candle power may be had, a scientific definition of the term will now be given and perhaps after this you will be able to tell the exact candle power of any light source you may see.

A standard candle power is one and one-hundred thirty-six thousandths times the light emitted by a standard Hefner lamp, which lamp with a wick of standard dimensions burns 120 grains of pure amyl acetate per hour.

The Lumen

Now that we have in mind the exact value of a candle power, you will agree, no doubt, that there is nothing particularly alluring about that definition and you will, therefore, be willing to drop the word candle power from our discussion and allow the introduction of a new term, which is called the "lumen." The definition of the lumen is "That quantity of light which will illuminate one square foot of area to a certain unit intensity." Thus, any illumination obtained may be measured by the lumens per sq. ft. of surface. For those who desire to think in terms of candle power, it can be stated that an approximate relation between the lumen and candle power, as

popularly understood, is 10 lumens per candle power.

Pardoning a crude illustration let us think of a lamp as a shell in which are contained a number of small insects. When the lamp is turned on, it is the same as opening the shell and releasing the insects. These may be thought of as all flying in straight lines in every direction from the shell until they strike some surface on which they rest. Now, the degree of illumination of the surface depends directly upon the number of insects that have stopped in each square foot of the surface under consideration. If a higher illumination is desired on this particular surface, one of two things must be done. Either more bugs must leave the shell (i. e. lumens in the lamp) or the surface must be placed nearer the shell so that more bugs will light upon it.

Thus, if a certain intensity of light is required, the strength of the light sources and their distances apart must be adjusted in such a way as to get the desired number of lumens per square foot. With street lighting, it is hardly necessary to go to light bugs or lumens per square foot and when dealing with streets of ordinary width, the width dimension may be ignored and the illumination calculated in lumens of source per linear foot of street. This is the measure of illumination which is used throughout this discussion.

The Incandescant Lamp

Our sources for street lighting at the present time are practically limited to two types of units. The first to be considered is the unit known as an incandescent electric lamp. This lamp is at present manufactured in practically all sizes from the "grain of wheat" lamp, used in surgical work and taking approximately six ten-thousandths of one horsepower, to the powerful lamp brought out recently for motion picture work, which consumes over forty horsepower, or nearly 67,000 times as much as the first. These incandescent lamps consist essentially of a tungsten filament housed in a glass bulb from which the air has been exhausted and either left thus or refilled with inert gas, usually nitrogen. The mazda type C lamp so much used for street lighting is the latter of these units. It can be obtained in single units hanging from 600 to 25,000 lumens. These lamps are of high efficiency and have no working parts to get out of order. They produce a satisfactory light and when used with proper reflecting, diffusing or refracting glassware, the distribution of this light can be very accurately controlled. This source has no sparkle or scintillation and will operate without attention until it burns out.

The Luminous Arc Lamp

The second source practicable for street lighting is the luminous arc lamp which is made in a number of sizes for both pendant and post mounting, ranging from 4,700 to 13,800 lumens. The latter type is known as the inverted. The form in which this unit is on the market today is known as the Magnetite lamp. The light comes from the arc or flame which is set up between the two electrodes. The positive electrode consists of a steel tube filled with a composition of magnetite, an ore of iron. The negative electrode is a block of copper. This lamp requires direct current for its operation and care must be exercised to see that the current flows from the magnetite to the copper and not in the opposite direction. A reversal of this lamp gives a greenish light of low brilliancy which is easily recognizable. As may be seen, this source of illumination requires a much more elaborate equipment at the central station entirely different from that used for other loads. These lamps are usually operated with about fifty lamps in each series circuit and they must be trimmed, i. e. the magnetite electrode replaced, quite frequently. This tends to give good maintenance. The lamp has a sparkle and snap not found in the incandescent lamp. Some of its characteristics are: its working mechanism with those troubles which come with any device having moving parts; its inherent large illuminating capacity; and the type of central station equipment demanded. The color of this lamp more nearly approaches daylight, is different from that used for show window illumination, and the contrast is pleasing.

Fixtures

The erection of the lamps just considered can be divided into two classes as to whether the units are to be fed from overhead wires or underground cable systems. Either method is possible in practically all streets, but the expense of construction is the main determining factor. Often a combination of the two methods of supply is found where a so-called ornamental type of street service is carried on poles. In this case, ornamental or post lighting has the result of placing a number of extra poles in each block. Where trolley poles are in a street it is sometimes practicable to use these for the sup-

port of the lamp fixtures. In general the type of support is a matter of local taste and this committee does not recommend any particular type of equipment for this purpose.

In this connection, however, your committee wishes to make it clear that bare lamps without reflecting, refracting or diffusing auxiliaries should never be used.

The committee also recommends that the minimum source of illumination be a lamp of one thousand lumens. Under usual conditions, the height to source should not be less than 10 ft. for the smaller units or over 25 ft. for the larger.

The committee recommends that on all wide streets, the light sources should be placed on both sides of the street.

Recommendations

Now that a basis for specifying street illumination, that is, in lumens per linear foot of street, has been determined; that the possible sources of illumination, namely the incandescent lamp and luminous arc lamp, have been discussed; that the methods of erection, overhead and underground feed, have been mentioned, definite recommendations as to the minimum of illumination required for such lighting can be made.

Outlying Districts

The first class of street lighting to be considered is that of the outlying districts, which are occasioned by the growth of the city and the removal of large numbers of families from the centers to take up residence in newly developed sections. These sections must be safely lighted. Your committee, after careful consideration, has decided that an illumination of 10 lumens per linear foot of such street is the least that should be provided. This illumination can be approximated by the use of 1,000 lumen lamps placed on each pole or by 2,500 lumen lamps, placed on every other pole, assuming the usual pole spacing.

It is interesting to note that the average lumens per foot of street for all streets of all cities of New York State on which data was obtained is now about 10, or the amount recommended for outlying districts.

Fully Developed Residence Streets

For the second classification, namely, the fully developed residential districts, your committee recommends a minimum of 15 lumens per foot. This can be approximated with a 4,000 lumen lamp placed on every other pole.

Main Thoroughfares

For the third class of streets the fully developed residential street with dense traffic, a minimum illumination of 35 lumens per linear foot of street is recommended. This can be obtained approximately with 4,000 lumen lamps spaced 120 ft. or 6,000 lumen lamps spaced 150 ft.

Business Districts

For the remaining classifications, business districts, the minimum required is suggested but in very few cases, no doubt will this amount be installed, but rather considerably more. The lumens per foot recommended as minimum are as follows:

	Lumens
City of population up to 20,000	60
City of population from 20,000 to 50,000	80
City of population from 50,000 to 100,000	120
City of population from 100,000 or over	200

with a maximum distance between standards of 125 ft.

In this connection, it is recommended that secondary business streets adjoining main business streets (including any warehoue or wholesale districts) be equipped with lamps of the same or similar design to that on the main street, but that the illumination be approximately one-half the lumens per linear foot.

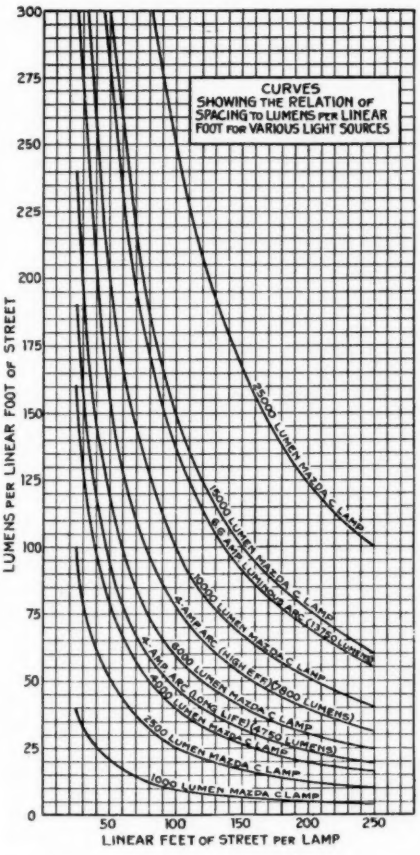
In many cities certain of the classes of illumination are already exceeded but in no city are the recommendations as given met in all particulars. It is the unanimous belief of this committee that the values recommended are the least which can be used on the streets of any city which would be considered well lighted.

In the discussion of the report, Mr. W. P. Capes, Secretary of the New York State Conference of Mayors, called particular attention to the recommendation that the assessment for special lighting be on the curb foot, rather than the property valuation basis. He stated that the second-class cities law and certain city charters provided for assessment on the valuation basis, but that under the Home Rule Amendment and the Enabling Act local amendments could be made to provide for assessment on the curb foot basis.

Mr. E. A. Fisher, Consulting Engineer of the City of Rochester, also spoke on this subject. He read the following general ordinance passed by the city council of Rochester April 23, 1912:

"Section 1. That wherever the residents of any street desire a change in the method of lighting, the cost of which, in

the opinion of the City Engineer, is in excess of the amount of funds appropriated by this Council available for the lighting of said streets, the change may be made upon the adoption of a local improvement ordinance assessing upon


CURVES
SHOWING THE RELATION OF SPACING TO LUMENS PER LINEAR FOOT FOR VARIOUS LIGHT SOURCES
LUMENS PER LINEAR FOOT OF STREET
LINEAR FEET OF STREET PER LAMP
25000 LUMEN MAZDA C LAMP
15000 LUMEN MAZDA C LAMP
6.6 AMP. LUMINOUS ARC (13750 LUMENS)
10000 LUMEN MAZDA C LAMP
4 AMP. ARC (HIGH EFF.) (7800 LUMENS)
6000 LUMEN MAZDA C LAMP
4 AMP. ARC (LONG LIFE) (4750 LUMENS)
4000 LUMEN MAZDA C LAMP
2500 LUMEN MAZDA C LAMP
1000 LUMEN MAZDA C LAMP

the abutting property such excess cost as estimated by the City Engineer.

"Section 2. This ordinance shall take effect immediately"

Mr. Fisher stated that at present 52 streets, covering about 30 miles, are lighted under the provisions of this general ordinance. In all cases the assessment is on a front foot basis and this system has proved very satisfactory over the 12-year period. The total average cost of this special lighting is about $1.00 per lin. ft. of street. Approximately two-thirds of this amount is paid by the city and one-third assessed on the property. The cost per front foot to the property owner varies from 10 cts. to 35 cts.

ELECTRIC RAILWAYS—DO WE NEED THEM?

By B. C. Cobb, Vice President Hodenpyl, Hardy & Co., Inc., New York, N. Y.

(Editor's Note: The following is an address delivered by Mr. Cobb at the Eleventh Annual Business Conference of the Babson Statistical Organization, on Aug. 8, 1924. We are glad to reproduce it here in line with our policy to give both sides of all questions of interest to our readers. If anybody can make out a good case for the electric railway, whether urban or interurban, it ought to be a banker who wishes to safeguard the money invested in such properties. In general, Mr. Cobb takes an advanced position, especially in respect to urban transportation.

His ideas are constructive. His discussion is as free from bias and prejudice as any man could write in 1924).

The degree of financial success attainable by any business is regulated by two factors. First, there must be a market for the product. Second, the price received for the product must be sufficient to pay all the costs of supplying it, plus a reasonable return to those who represen the capital invested. The electric railway business is no exception to these elementary but fundamental economic laws. On them rests the answer to the question regarding the permanency of the electric railway as a public servant —the question singled out for discussion today.

TABLE SHOWING THE RELATION OF SPACING TO LUMENS PER LINEAR FOOT FOR VARIOUS LIGHT SOURCES

ILLUMINATION—Lumens per foot

	Linear Feet of Street per Lamp							
Size and Type of Lamp	50	75	100	125	150	175	200	250
25000 lumens Mazda C	500	334	250	200	166.6	142.8	125	100
15000 lumens Mazda C	300	200	150	120	100	85.6	75	60
6.6Amp. Arc 13750 lumens	266	184	138	110.5	92	78.9	69	55.2
10000 lumens Mazda C	200	133.3	100	80	66.7	57.1	50	40
4 Amp. Arc "High Efficiency" 7800 lumens	156	104	78	62.4	52	44.6	39	31.2
6000 lumens Mazda C	120	80	60	48	40	34.3	30	24
4 Amp. Arc "Long Life" 4750 lumens	94	62.6	47	37.6	31.3	26.9	23.5	18.8
4000 lumens Mazda C	80	53.3	40	32	26.7	22.9	20	16
2500 lumens Mazda C	50	33.3	25	20	16.6	14.3	12.5	10
1000 lumens Mazda C	20	13.3	10					

Evolution in Urban and Interurban Transportation

I am not going to burden you with a long-winded historical and statistical review of the electric railway industry, but I am going to refer as briefly as possible to the evolution that has taken place in urban and interurban transportation. It is said that the first street railway in this country was operated on Fourth Avenue, in the City of New York, in 1832, the cars being hauled by horses over light strap rail. From this crude beginning afterwards came the cable car, which was introduced to the San Francisco public in 1873. This advance in the art was succeeded by the establishment of an overhead trolley system in Richmond, Virginia, in 1888—and there began the electric railway systems that have since been developed.

Advent of the Automobile

From 1888 up to the year 1916 electric railways grew and prospered. Their securities were held in high favor among investors because they believed that generally speaking the local street car company had the exclusive right to furnish an indispensable service to the public at a price fixed to yield a satisfactory profit. They reasoned that the business was operated on a cash basis, that it required a moderate working capital, and that the riding habit would grow with the increase in population of the communities served. These factors seemingly combined to make a very satisfactory earnings position. This reasoning and these factors, however, were somewhat disarranged and interfered with by the advent and the development of the automobile. The market, because of this development, for public transportation by 1916 was undergoing an important change. This change at first was almost imperceptible. It has been gradual but far reaching ever since and it has caused those responsible for the management of traction properties many anxious moments, and likewise has it aroused misgivings in the hearts of many people owning traction securities as to the safety of their investment.

In 1913 approximately only 1,200,000 passenger automobiles were registered, or one automobile to approximately every ninety persons in the country. By 1923 this registration had grown to over 14,000,000, or one automobile to every eight persons. Under ordinary conditions the electric railway industry would have take more serious cognizance of this new form of competition and would have prepared to meet it, but the war and its disastrous consequences upset everything and made impossible many things that perhaps would have been done. You are familiar with what took place in the way of increased cost in all lines of business, and with what happened to the electric railways with the price of their product fixed on a pre-war basis and their ability to increase such price surrounded by many difficulties. It is sufficient to say that they were harder hit and suffered more financially than any other large industry.

Public's Riding Habit Changes

Probably the most important change remaining, after many fare adjustments had been made to meet the prevailing cost of operation, was the change in the riding habit of a large part of the public —a change that seriously affected the market for the service rendered by the electric railways. The development of the automobile with its numerous types of cars offering varying degrees of speed, style and comfort made the cost of individual transportation a very minor consideration to many people. In fact pleasure vied with utility in transportation service. The public wanted variety in its form of transportation, the same as it wanted variety in its forms of pleasure. For example, the person who had acquired the desire for good music and had the money to gratify it was comparable to the person who bought a high price motor car. The person who had acquired a taste for musical comedy and had the money to gratify it was comparable to the chap who bought a medium price car. Again, a large number of people who no doubt would enjoy but could not afford either type of entertainment mentioned was comparable to those who bought a low price car.

Thus the market for organized public transportation was affected to a considerable extent by the increasing number of people who daily transported themselves in their own cars. This evolution in transportation left the street car company in the position of handling the large mass of so-called "necessity riders"—those who did not own automobiles, and in a great measure it took away the cream—the overloads and the fill-ins.

The Motor Bus

Along with the development of the family passenger automobile also came the development of the motor bus operated as a

public utility for group transportation. The automobile appeal has been so strong and become so popular that the thought in the minds of many people has been that this new type of transportation service would sooner or later entirely supplant the service rendered by the electric railway. It has gradually become apparent, however, that neither the street car nor the motor bus by itself can give the public in most of our cities the combination of pleasure and utility it desires in all the year round transportation facilities. Each form of transport has certain operating limitations and advantages over the other. Conditions vary, of course, with the character and size of the city served but generally speaking, it has been found that the electric railway can carry a larger number of people in a given time over more extended areas than any other form of surface transportation. It has also been found that street railway operating costs under traffic density conditions usually are lower than those of the motor bus. The principal reasons for this are:

Advantages of Electric Railway

1. The electric railway car's right-of-way on fixed steel rails makes for greater speed and incidentally for smoother riding than in motor buses operated on paved streets.

2. The average electric car in large cities is capable of carrying from 100 to 110 passengers as compared with from 50 to 60 passengers carried by the modern type of double-deck motor bus.

3. The electric railway interferes less with the use of the city streets for other purposes.

4. The electric railway car is the more practical and a safer form of transport under unfavorable weather conditions.

Advantages of Motor Bus

The principal advantages of the motor bus are:

1. Its ability to start and stop more quickly than the electric railway car.

2. Its greater flexibility of movement because of not being confined to a fixed right-of-way.

3. A fascination generally present with something new.

From the financial side, the investment in the fixed property of the electric railway, because of construction costs, usually is larger than the property investment of the bus, the right-of-way of which at present is the city streets where the cost of construction is borne by the public. For the same reasons, the cost of maintaining electric railway systems obviously is larger than the cost of maintaining motor bus systems, as their expenses of this character generally apply only to equipment.

This fixed capital advantage of the bus, however, plus the savings in maintenance mentioned, are counteracted to some extent by certain advantages held by the electric railway car. The large size electric car and the double-deck bus each requires two operators. In the case of single deck buses only one operator is required, as is the case with one man safety-cars in operation on many lines. The unit cost for each revenue passenger carried frequently is lower in the case of the street car on account of the larger number of passengers carried. The cost of motive power in the case of the electric car usually is slightly lower, but a much more important item in operating costs is the life of the equipment. An ordinary street car that has been maintained, will give upwards of twenty years of service. In the case of the motor buses no hard and fast depreciation rule has as yet been laid down, but it is generally conceded that a motor bus has a service life of from four to five years, or say, two hundred and fifty thousand miles. This item of depreciation is a very important one for both electric railway and motor bus companies, and it can be truthfully said that at least 25 per cent of bus value as against 3½ per cent to 5 per cent of car value should be charged off each year for this purpose.

In the item of taxes the motor bus has a material savings advantage over the electric railway, which is obliged to meet a variety of burdensome tax obligations that are not placed on the bus.

Public Interested in Results

I am not going into definite investment and operating costs of electric railways versus motor buses, and my remarks on account of the number of variable factors which exist in practically every city of any size and population must of necessity be general in their character. It is my opinion, however, that the great traveling public is not so much interested in processes as in results, and the results in this instance are the character and cost of transportation service.

Traffic density and congestion in many of our cities makes the electric railway the best and most economical form of mass transportation known. Outside of the rush hours, however, and in sparsely settled portions of a city the motor bus at present has an advantage, but this ad-

vantage cannot be considered permanent as the time surely will come when the motor bus will be obliged to pay a proper proportion of the cost of maintaining the roadbed provided by the public. Furthermore, the motor bus eventually will come under regulations as to schedules and routes similar to those that now apply to the electric railway. In other words, the bus cannot always expect to select the routes and time it desires to operate, but as a public utility it must be organized to give city-wide transportation service at regular intervals of the day or night whether or not any passengers are waiting on the corner to be picked up.

The electric railways under proper franchise restrictions and requirements, with their organization, equipment and years of experience—all of which represent the investment of between $5,000,000,000 and $6,000,000,000—are pre-eminently the best qualified to, and should operate in the interests of the traveling public, such motor buses as may be required to round out and improve existing city transportation systems.

As the editor of a leading motor bus magazine said a few months ago in commenting upon the efforts to motorize Akron, Ohio, "After all the main lesson from Akron is this—the bus has its place; so has the street car. For city service of the kind demanded by the American public the local transportation system must use both buses and street cars, and the service of each must be co-ordinated with the other. One management in charge, to use each facility in its place—this is the rubber city's latest message to the transportation world."

City Authorities Must Solve Traffic Problem

The mere combination of the electric railway and the motor bus, however, is not going to entirely solve the problem of city transportation. Both electric railways and motor buses are confronted with an exceedingly serious problem, and until it is solved or relief is granted from present conditions the matter of rendering quick, efficient and dependable transportation in cities is going to be increasingly difficult. I refer to the traffic congestion caused by privately owned automobiles.

At the time the streets in our cities were laid out automobiles were unheard of and therefore not considered when the widths of the thoroughfares were decided upon. With an increase of over 15,000,000 in the number of motor vehicles registered during the past twenty years and little or no provision made for the adequate handling of this traffic, it is high time that some concerted effort is made to relieve the situation in the interest of the traveling public, and when I say this I include the automobile owner, the property owner, the business man, and the ordinary pedestrian. In fact, I do not know of any business interest that would not be benefited by relieving traffic congestion.

I do not blame the automobile owner for this situation. It is not his fault—nor is it entirely up to him to help out. In most cases it is primarily up to the municipal authorities themselves to make a more intensive and extensive study of each local situation. Instead of contenting themselves with the erection of a few parking signs and the setting up of a few traffic regulations, they should organize a City Transportation Bureau similar in its duties, scope and powers with respect to action for the public welfare as those possessed by the Bureau of Health, the Fire Department and the Police Department. Such a Transportation Bureau in the making of plans for better taking care of traffic should consider not only the existing conditions but those which in all likelihood are going to come about as the city increases in size and population. This is a big job but it can be done. Indianapolis and some other cities, for example, now have City Planning Commissions which are making progress in this direction. Extensive traffic surveys have been made and the various streets and thoroughfares are being classified, set apart and improved for the better taking care of traffic. Plans are being made for automobile speedways and boulevards so that local and rapid transit may be separated. Some streets are being designated as heavy traffic streets, with special reference made to the detouring of traffic that is not coming from or destined to the main business district. In addition, the Commissions are working out plans to improve routings of the electric railway cars and buses, particularly in the congested districts, with a view of improving the entire public transportation system of the cities.

When one considers the tremendous waste of time and money and the great personal inconvenience caused to a large portion of a city's population on account of traffic congestion, it seems almost unbelievable that more and better organized steps have not been taken to remedy such conditions. Surely it is an economic prob-

lem of sufficient concern to deserve the consideration and support of every citizen. It has been proposed in some instances to widen the main streets of cities but as a practical matter this cannot very well be done and if done, would involve the expenditure of large sums of money which would have to be raised by taxation—and most people rightfully believe that the taxation business has about reached the limit of financial endurance.

The Parked Automobile

Much relief could easily be given, however, if city authorities would see to it that street cars, on account of their carrying such a large number of people, are given precedence over every other form of street traffic. This regulation should be enforced by making it a misdemeanor punishable by arrest and fine of anyone who unnecessarily interferes with the progress of a street car—a condition which exists today in Cleveland. Streets are intended for vehicles to travel on, the same as sidewalks are intended for people to walk on. The right of stoppage on them is only incidental to the right to use them for the purposes for which they were designed. The parking of automobiles along the curb narrows the roadway and throws the course of travel toward the middle of the street and thus slows up the progress of street cars and motor buses and interferes with the normal daily movement of people to and from their places of business or pleasure. The parking of cars also interferes with trade of merchants and in times of fire is likely to interfere with the work of the Fire Department, not only in the movement of apparatus along the streets but in making the fire difficult to handle. The parked vehicle surely must give way to the moving vehicle so that the street surface can be used for the purpose for which it was originally intended.

Traffic surveys recently made in several cities have shown that during the rush hours automobiles passing a given point in the main business section carried an average of only 30 per cent or 35 per cent of the travelers, whereas the electric railways carried from 65 per cent to 70 per cent. These figures certainly indicate that the street car should be given precedence over all other forms of public transportation, and that it is not yet a public nuisance—a thing to be done away with. It is not a matter of benefitting the street car company—it is more a matter of giving a large part of the public faster, more economical, and more dependable transportation.

Variety of Transportation

You may say that I am harping too much on rush hour traffic and that what the people want is a plan for reliable all day, all night, year 'round transportation service. This can be arranged by the electric railway company supplementing its regular service by the use of motor buses and in some cases taxicabs, the entire transportation system being organized and operated on a basis of furnishing service at rates based upon the character of the service, thus affording the variety of transportation which the public wants. If this were done, along with scientific planning of transportation thoroughfares and the enforcement of stringent parking rules, I feel confident that the benefits to everyone would be amazing, not only in the measure of comfort and convenience but in the measure of money value as well.

As I have said, the street car and the motor bus each has certain distinct advantages over the other. And I say further, in my opinion, the electric railway now in the field should operate both together, along with taxicabs, so co-ordinating the respective utility features of each that more efficient transportation service can be rendered. The co-ordination of the electric railway and motor bus service is not a theory. It is now and has for several years been a fact with many traction companies. One company with which I am connected has at present seventy motor buses supplementing its city railway service and thirty motor coaches supplementing its interurban service. No active steps have as yet been taken by any traction company, so far as I know, to operate taxicabs as a part of its transportation service, but it seems to me to be a logical development for the future.

Future Market for City Transportation

I do not think we should be concerned about the market for service—I mean, I do not think the transportation man should worry about the insufficiency of passengers, for I am sure that the people are beginning to go back to street car riding and are learning to patronize motor buses and taxicabs in preference to using their own automobiles. I am further sure that this swing back to group or public transportation is going to increase rather than decrease during the coming years.

Increase in population will help to a certain extent, but another and perhaps more compelling reason is the expense in-

volved in any other method of transportation. When the idea finally takes hold that the cost of operating privately owned passenger automobiles runs from 10 cents to 25 cents a mile, it is extremely likely that financial necessity will result in more discrimination in their use. Thus, those who sell a combination of electric railway, motor bus, and let us say taxicab service too, should find a steadily increasing market for their offerings in most of our cities, particularly those with a population of 100,000 and upwards. In the case of cities with a population of less than 100,000 the problem of the electric railway is exceedingly difficult despite increased fares, the use of one-man cars, and other changes for the better, for after all, the principal factor is the volume of traffic—the market in which to operate. It may well be in many of the small cities, although conditions vary greatly, that the motor bus will supplant the local electric railway insofar as public transportation service is concerned. I venture the opinion, however, that few (if any) successful attempts will be made to give adequate and regular year 'round transportation service in this way in cities of any size. The electric railway companies are prepared to render this service if given proper support by and cooperation of the community. Such support necessarily means the right to charge an adequate rate of fare and protection from unreliable and irresponsible competition. If the authorities in many places had been as responsive to the needs of the traction companies as they were ready to welcome competitive bus service to which they granted higher rates of fare there would be fewer traction companies today struggling in their efforts to perform. It is the old story in many instances—welcome the "outs" and throw out the "ins."

Some Figures for 1923

I do not fear that the motor bus will replace the electric railway in the larger cities for, contrary to the opinion of many people, the revenue passengers carried per capita in such cities last year showed material increases over 1910, and in some instances over 1922. This is of considerable significance when we remember that in 1910 there were only 468,000 motor vehicles of all sorts registered as compared with approximately 15,000,000 at the end of the year 1923. It also surely is of interest to know that in 1923 the electric railways of this country carried approximately 16,000,000,000 passengers, or in other words more passengers than in any other year in their history. This very clearly demonstrates the economic need and usefulness of the industry. It cannot be possible that an industry that carried this huge number of passengers in one year—twelve times as many as were carried by the steam railroads—is ready for burial.

I have no sympathy for the railway man who deprecates the automobile and the motor bus. He is of the dark ages. Both are instruments of progress, and while their indiscriminate use on the streets of our cities has interfered with the efficiency and usefulness of the electric railway—the service of which is required by such a large number of people—they cannot be denied and should be used in a proper way for the benefit of the whole.

Evidences of Progress

I think that most railway operators in the country are constantly devising ways and means of increasing the earnings of their companies, and I believe they are at the same time not neglecting any operating efficiency or service that will be of benefit to the public. It has been and still is an up-hill job, but progress is being made. For example:

1. One-man safety cars (which cost about as much as the ordinary single deck bus) have been placed in operation by many companies, and their use generally has resulted in operating economies together with improved service to the public.

2. Traffic studies and surveys have been made and car routings changed with benefit to the public and savings to the companies.

3. Service during rush hours has been speeded up by the adoption of skip-stop schedules and the use of "Pay-as-you Leave" cars.

4. Safety zones and loading platforms have been established in congested districts.

5. Motor buses have been operated in territory not directly served by car lines and free transfers exchanged.

6. Lighter cars have replaced heavy equipment and new types of motors better adapted to the service have been installed.

Various other changes and improvements are going on, and a better feeling of good will on the part of the public and the authorities has manifested itself through adjustment of fares to meet increased operating costs and taxes, and likewise the elimination of unfair motor

bus and jitney competition and relief from burdensome franchise restrictions have been helpful.

Thus the two old fundamentals of sufficient market and adequate rates of charge have begun again to assert themselves. These things, together with a public more friendly than it has ever been before because of its better grasp of the electric railway situation, surely should make tractionmen face the future with renewed courage. True, earnings have not yet shown much of an improvement, but operating expenses are getting under better control and later on earnings will surely come. I realize that my word is not sufficient, but as students of finance you must have noted the change for the better that has taken place in the market price of traction securities within the past year. You also must have noted that some traction financing has been successfully accomplished during that period. If security prices indicate the future, then the rise in value of traction securities confirms what I have said. This improvement in the value of traction securities of companies doing business in cities of size and population will in my judgment continue, owing to the need of the people for an indispensable, economical, safe and quick transportation service. I believe also that the next five years will prove what I say is true. At any rate, the changes that are taking place in the transportation field—the further unfolding of the panorama—will at least be interesting.

Interurbans Developing Freight and Express Business

What I have said in the foregoing applies largely to city transportation service, but much of it applies equally as well to interurban service, which, along with city railway service, has had its fair share of the vicissitudes and problems that have confronted all railway companies—steam and electric alike—during the past few years. Without going into the history of interurban railway building and expansion, I would not speak truthfully if I did not acknowledge that many of them were constructed without proper thought as to their then-time necessity or their outlook for the future. True, they have done much to develop our suburban territory and have in many instances given railway service to many communities lacking it. On the other hand, steam railway service was in just as many instances unwarrantedly interfered with and hurt—and without resultant benefit to anyone. It is just this sort of unwarranted interference and unnecessary competition from unregulated buses and automobiles which has in recent years made the pathway of electric railway stony. Two wrongs do not make a right, and if we learn as we go along we should see to it that this mistake is not repeated.

Some interurbans are going to fall by the wayside—in fact a number already have reached the scrap pile. There are others however, and they are in the majority that will continue to serve with credit to their management and to the benefit of their patrons and their shareholders. Unlike the steam railroads, which derive 80 per cent to 90 per cent of their business from the handling of freight, the interurbans have depended largely in the past upon passenger business to keep them going. A change in this respect, however, has taken place in the past few years and many interurban roads are now doing a thriving freight and express business—and this without detriment to the steam railroads, the facilities of which have been strained to the utmost.

And now we come to another phase—the growing competition from interurban motor buses and trucks. This curse, and I say it advisedly, cannot long continue—not if the American people are mindful of their interests—I mean this sort of competition cannot long continue unregulated and allowed to operate at its own sweet will. The highways are built for traffic—traffic of the individual, the farm owner, the pleasure driver, and the pedestrian—as thoroughfares for those who in their private capacity would go from one place to another—not for use by incorporated companies and unincorporated individuals owning buses and trucks as rights-of-way for the conduct of a public transportation business. While it is true that this form of transportation pays in a measure some taxes into the public treasury for the privilege of using the public highway, it is also true that it does not pay enough by any means to adequately repair the damage it does to the roadway. I do not believe, as I have already said, that this use of the highways can long continue without proper payment on the part of those using them. It is manifestly unfair not only to the railways, who are forced to maintain their own rights-of-way and in addition are compelled to pay high taxes on their value as property belongings—but it is also unfair to the private individual—the property owner along the

highway—who foots the bill for paving and repaving whether or not he derives any benefit for so doing.

While many of the things I have said are not strictly germane to the subject in hand, I could not very well pass them by, for they are part of the very essence of our problem—so interwoven with its fabric as to make it difficult of unweaving.

If I have bored you, you must forgive—if you do not agree with what I have said, that is your privilege. I am not a soothsayer, a prophet or a seer, nevertheless I believe that with co-ordination and the doing away with ruthless competition, which in the end only means disaster for all, the electric railways will "come back." They are, in my opinion indispensable and will continue so to be for many years to come.

RECOMMENDED PRACTICE IN OILING EARTH ROADS

(Editor's Note: The data and recommendations here given are from circular No. 11, issued by the Engineering Experiment Station of the University of Illinois, entitled: "The Oiling of Earth Roads." The circular was prepared by Wilbur M. Wilson, Research Professor of Structural Engineering. It is based on an investigation of oiled earth roads conducted by the University of Illinois during 1922 and 1923.)

Approximately forty million gallons of road oil were used on the highways of Illinois during the year 1923. The cost of this oil, applied to the roads, was about three million dollars. It is highly important that a method of road construction involving such a large sum be developed to its greatest effectiveness.

The use of road oil as a means of preserving the roads of Illinois has not been an unqualified success. Some oiled roads have been complete failures, but in the majority of cases a moderate degree of success has been obtained. Many oiled roads constructed by regular road officials have remained in good condition throughout most of the year. The high degree of success obtained in some cases emphasizes the possibilities of oiled roads when properly constructed and maintained, and likewise emphasizes the economic loss due to inferior practices.

Causes of Failure of Oiled Roads

As a result of observations on the experimental roads and on other roads in central Illinois, the following are considered the most important causes of failure:

1. The quantity of oil applied was insufficient.

2. The road was covered with dust at the time the oil was applied.

3. The roadbed was not thoroughly consolidated at the time the oil was applied.

4. The oil was of such a character that the oiled earth did not have sufficient binding properties.

5. The oil was of such a character that the oiled mat separated from the subgrade.

6. The soil was spongy and the subgrade did not have sufficient structural strength to support the oiled mat.

7. The road was not properly shaped, and water, unable to run away, formed puddles in the road.

8. The side ditches did not have outlets, causing the watertable to stand near the surface of the roadway and weakening the subgrade.

Annual Cost of an Oiled Road

To be well maintained, an oiled road must be oiled each year; the cost of oiling is, therefore, a maintenance charge. The annual cost per mile of a high grade oiled road has been determined upon the basis of the following assumptions:

a. That all culverts have been installed and the heavy grading has been completed some previous year.

b. That a large grader outfit makes two rounds on the road early in the spring, one round cleaning the ditches and one round distributing the spoil over the roadway;

c. That the road is maintained by a patrol system for two and one-half months;

d. That a strip 12 ft. wide is oiled at the average rate of 3 qts. per sq. yd.;

e. That the oil costs 7 cts. per gal. applied.

On this basis the annual cost per mile of an oiled road is as follows:

Two rounds of the big grader	$ 10.00
Patrol, 2½ months at $15 per mi. per mo.	37.50
5,280 gals. of oil at 7cts. per gal.	369.60
Total cost per mi. per year exclusive of the cost of culverts and the original heavy grading	$417.10

Many roads, because of lack of funds,

will be given a less thorough treatment. The method of analyzing the cost of a high grade road may be used to determine the cost of a cheaper construction.

Some counties are oiling a strip only 8 ft. wide and are applying an average of less than 3 qts. of oil per sq. yd. Where the traffic is light an oiled strip 8 ft. wide may be sufficient, but where there is moderate traffic the narrow strip will not permit it to be properly distributed. Where the drainage is excellent and the soil is firm over a considerable portion of the road the quantity of oil possibly may be reduced somewhat below 3 qts. per sq. yd.

If the width of the oiled strip or the quantity of oil is reduced the cost per mile can be adjusted accordingly. It is believed, however, that the figure given, approximately $420 per mile per year, represents the cost of a high grade oiled road, that, under moderate traffic and with the soil and drainage conditions existing in Central Illinois, will remain in fair condition throughout most of the year. A good road can be obtained at this price only if care is exercised to eliminate causes of failure when the road is constructed.

Recommended Practice

As a result of observations on the experimental roads and on other roads in Central Illinois, the following practice is recommended for constructing a high grade oiled road of loam and clay soils similar to those found in central Illinois:

1. Bring the road to a hard smooth surface each year. If the road is not well shaped it should be completely regraded. If it has been previously graded, a large grader outfit should be used to clean out the ditches; one round in the ditches and one round on the shoulders spreading the spoil are usually sufficient. This work should be done early in the spring.

2. Maintain the road with a patrol, beginning as soon as the grading has been finished or the ditches have been cleaned. If a motor patrol is used, a separate outfit should be provided to work on the places that have a tendency to soften.

3. For a roadway 28 ft. wide, give the road a crown of approximately 9 ins. where the soil is firm, and of 12 to 15 ins. where the soil is spongy.

4. Delay oiling until the roadbed is thoroughly consolidated.

5. If the road is dusty, scrape or sweep the dust off before oiling in order that the oil may penetrate into the solid body of the roadbed.

6. Put on enough oil to make a good road. For a firm soil well drained, 3 qts. per sq. yd. is recommended for a road being oiled for the first time, and 2 qts. per sq. yd. for a road that has been oiled successfully the previous year. Portions of the road where the soil conditions are not favorable should receive 1 to 2 qts. of oil per sq. yd. in addition to the amounts specified above. This additional oil should be applied in the fall and it should be applied to those portions of the road where there are indications of failure.

7. Use oil that contains a solid residue content of at least 55 per cent.

8. Apply the oil with a pressure spreader.

9. Heat the oil before it is applied.

This recommended practice contemplates a road subject to the heaviest traffic that an earth road may properly be expected to carry. It is realized that road officials do not have sufficient funds to oil all the roads in accordance with these recommendations. Moreover, there are many roads that do not carry sufficient traffic to justify the construction of a high grade oiled road that are, nevertheless, of sufficient importance to justify an attempt to make them passable for automobiles throughout the year. No attempt has been made to formulate recommendations for the construction of roads carrying light traffic because sufficient data are not available to answer the large number of questions involved. There are, however, two pertinent facts bearing upon these questions that are quite evident:

1. In the analysis of the cost of a high grade road, herewith given, one-sixth of the total cost is for the preparation of the roadbed and five-sixths for the oil.

2. Experience teaches that a good roadbed is absolutely essential for the construction of a good road.

These facts indicate that, if the cost of a road must be reduced, it should be reduced by decreasing the amount of oil rather than by neglecting the roadbed. Too much emphasis cannot be placed upon the necessity of having a roadbed that is smooth, well shaped, thoroughly consolidated, and free from dust and loose earth before the oil is applied. One dollar spent on preparation of the roadbed is worth many dollars spent for oil. Parts of the road that are most likely to disintegate should receive special attention, both in grading and oiling.

METHODS OF REPAIRING BLOCK PAVEMENTS IN BALTIMORE

By Nathan L. Smith, Associate Civil Engineer of Highways, Paving Commission, Baltimore, Md.

The City of Baltimore embraces approximately 14,600,000 sq. yds. of street area, paved and unpaved, private alleys excluded. Of this area, improved paving has been laid on about 10,150,000 sq. yds., or 70 per cent, leaving 4,450,000 sq. yds. either unpaved or covered with cobblestones or blocks on non-rigid foundation. Areas covered by various types of block pavements are as follows: Vitrified, 1,435,000 sq. yds.; granite, 1,100,000 sq. yds.; wood, 61,000 sq. yds. The granite and vitrified areas are increasing yearly, but no wood blocks have been laid for many years.

In 1923 approximately 40,000 sq. yds. of vitrified brick paving, or less than 3 per cent of the total area of this type of pavement, was taken up and repaired. Likewise it was found necessary to repair 33,000 sq. yds. of granite block pavement, or 3 per cent, and 3,500 sq. yds., or 6 per cent of wood blocks. Of these areas, about two-thirds were on general maintenance and one-third where the street had been cut to repair or renew some underground utility.

Methods of Repair of Block Pavements

The specifications for repairs to block streets are essentially the same as those for new work of the same character. The blocks are removed and stored at some point adjacent to the work where interruption to both vehicular and pedestrian traffic will be slight, and the asphalt or grout filler which adhered to them is cleaned from all which are satisfactory for relaying, either by air compressor or hand chisel or hatchet. Repairs are made to the base if necessary, and after it has set up sufficiently a new mortar bed, proportioned 1:3, is prepared and the blocks repaved. Broken or defective blocks are replaced by additional ones, either new or used, supplied from the nearest storage yard. Whenever a street which was paved with block on sand is repaved with some other material on a concrete base, the old blocks are hauled to the nearest storage yard and stored for future use, either repair work as described in this paper, or for repaving on a concrete base, either redressed or not. In case a cut in a new granite block pavement is to be repaired, redressed blocks are used to make a more uniform surface.

Bituminous Filler

Asphalt filler is used almost exclusively on repair work, because the street is usually a busy thoroughfare, and the exclusion of traffic for a sufficient length of time for grout to properly harden works a hardship on general traffic as well as on the abutting property owner or his tenant. To properly protect a grouted repair by means of covering, barricades, and lights is an added expense which more than offsets the higher cost of the bituminous filler, the average truck or wagon driver being no respecter of such obstacles. Hot gravel ⅛ to ⅜ ins. in size is used in the joints of granite block repairs in accordance with the Standard City Specifications for this work, the gravel and standard asphalt block filler being poured alternately until the joints have been filled, after which the entire surface is covered with hot gravel.

A sand bed may be used instead of the mortar bed under vitrified brick repaving where asphalt filler is used, but not if the blocks are grouted. Dry sand is spread over the surface as soon as the final squeegeeing of the filler has been made.

Organization

All street repair work in Baltimore City is under the supervision of the highways engineer, appointed by the mayor. Under this official is the assistant highways engineer, in general charge of the engineering features of the department, including street maintenance, private alley construction, bridge construction and repair, etc. The assistant engineer in charge of maintenance, reporting to the assistant highways engineer, is in direct charge of all repairs. The city is subdivided into five districts—Central, Northern, Eastern, Southern and Western, each in charge of a district superintendent, reporting to the assistant engineer.

By far the greatest area of block paving is in the Central district, and the forces are organized accordingly. In this district there are five gangs on block repair work, each in charge of a foreman who is himself a paver. Three of these gangs, engaged in block repairs only, are composed of three pavers in addition to the foreman, one or two rammers and eight or ten laborers. The other two gangs, besides the foreman paver, consist of one paver and about five laborers each, the foreman doing the ramming. These gangs, when not en-

gaged on repairs to block streets, handle granite and concrete curb repairs and general maintenance of all kinds.

The suburban districts have at least one gang each in charge of a paver, organized similarly to the smaller gangs in the Central district. These gangs care for all the block repair work in their districts, unless the area to be restored is very large, in which case a large gang is sent out from the Central district. Suburban maintenance, however, consists mainly of shoulder and gutter work and macadam patching and resurfacing, an average of twelve gangs operating in each district.

If the area to be repaved in a certain section is small, consisting, say, of a few small cuts within a square or two of each other, one of the smaller gangs is assigned to the work. One or two of the laborers clean the rip-rap and dirt from the cut and prepare the cushion; then move on to the next cut while the paver places the blocks. The filler is then heated and applied by the rest of the laborers. The ramming is done either by the paver or the foreman-paver, depending upon whether the next cut is ready for paving. In case the paver is unable to keep up with the rest of the gang, the foreman helps with the paving, besides supervising the entire operation.

The larger gangs are assigned to work where the area to be repaved is at least 25 sq. yds., and preferably 50 sq. yds. This area may be in one patch, or may also include several small cuts adjacent thereto. If the latter condition exists, the foreman usually assigns one of the pavers and a couple of men to some of the cuts, while the main gang works on the large area. This procedure may be varied to suit conditions, taking into account the volume and nature of traffic, the shape of the area under repair, the demand for the opening of one portion of the work, etc.

Records

Accurate records of the work performed are kept by means of daily reports, made out by the foreman, approved by the district superintendent, and posted and filed under the direction of the assistant engineer. These report sheets show the location and nature of the work, the number, name, hours worked, rate per hour, and amount due each man engaged on the job, the kind and quantity of material received on, and excess material transferred from each job, the material and equipment used, and the length in feet and area in square feet of each repair. When some source other than the roads and streets maintenance fund is to be billed for the cost of the work performed, these bills can be accurately made up from the foreman's reports.

Wages

The rates paid the men engaged on repair work range as follows: Pavers, including foreman-pavers, $1 per hour; rammers, 87½ cts. per hour; foreman, other than pavers, 70 to 75 cts. per hour, and labor, 45 to 50 cts. per hour. Of the labor, the 45-ct. rate applies to the ordinary workman, while asphalt pourers receive 48 cts. and a few special men who can act as foremen if necessary, 50 cts. With two or three exceptions these men are paid for the actual time they work, the exceptions being high-class men who can be utilized in other capacities, and are paid straight time. The paver-foremen, pavers and rammers are all union men, their rates corresponding with union schedules.

The records compiled for last year's work (1923) indicate that the cost per square yard of repairs to block pavements were as follows: Granite, $1.55; brick, $1.77, and wood, $2.16. In explanation of these prices it might be said that almost no new granite blocks were used in this repaving on account of the availability of old blocks.

On the other hand, about 100,000 new blocks were used to replace defective bricks removed from the street, while the number of new wood blocks, 40,000, was still greater in proportion to the yardage repaired, due to the fact that all our wood block pavements are old. The bricks cost $40 for 3-in. and $42 for 3½-in. per thousand, while the cost of the wood blocks was $74 for 3-in. and $94 for 4-in. per thousand.

Although no mention has been made of it in this discussion, there are nearly 300,000 sq. yds. of asphalt block pavements in Baltimore, either on concrete base or on sand, and repairs were made on between 15,000 and 18,000 sq. yds., or 5 to 6 per cent thereof, in 1923. These pavements are old, and in bad repair; no new asphalt blocks having been laid for several years. When new paving crosses a street paved with asphalt blocks, the intersections are torn up and repaved with sheet asphalt or whatever material is being used on the work. The average cost of asphalt block repairs in 1923 was 90 cts. per sq. yd., old blocks

taken from other streets being used to replace broken blocks when needed. No new asphalt blocks were purchased in 1923.

The writer is indebted to Mr. Charles Foard, assistant engineer in charge of street maintenance, for much of the information contained in this discussion, and gratefully acknowledges his assistance.

The foregoing discussion by Mr. Smith was read before a conference on city paving recently held under the auspices of the Engineers' Club of Philadelphia, as reported in "Engineers & Engineering."

SUPER-POWER AND ITS RELATION TO PROGRESS AND PROSPERITY

By Lucius B. Andrus, Vice President and General Manager, Indiana Electric Corporation, Guaranty Bldg., Indianapolis, Ind.

(Editor's Note: The following address was prepared by Mr. Andrus for presentation at the new super-power station of the Central Indiana Power Co., at Dresser, Ind., on the Wabash River a few miles below Terre Haute, when the press of Central Indiana visited the station on Aug. 26, 1924. The address is a look into the future and indicates what we may expect in super-power development and as a result of it.)

I am talking on the subject of the most modern class of great industrial developments in this country, namely the Public Utilities. Only those who have had occasion to interest themselves in the development of the light and power industry have an appreciation of what has happened within that business during the last 20 years. Nor is it generally understood how this development has affected other industries, and in turn, how the light and power business has been affected by its more intimate relationship with industry.

Features of Historical Interest

It has been said that in order to derive a real benefit from a discussion of any subject it is necessary to trace, to a certain extent, the history of the subject under discussion in explanation of the changes which have taken place. The historical statements are brief and confined only to the prominent features of historical interest in their connection with the subject which is under discussion. Attention will be given in this discussion, first to some of the important developments in the light and power business; second, to some of the advantages of these changes and to the reasons why such changes have occurred. A real understanding of this question has become essential to the citizens who would grasp the meaning of the development which is going on about him.

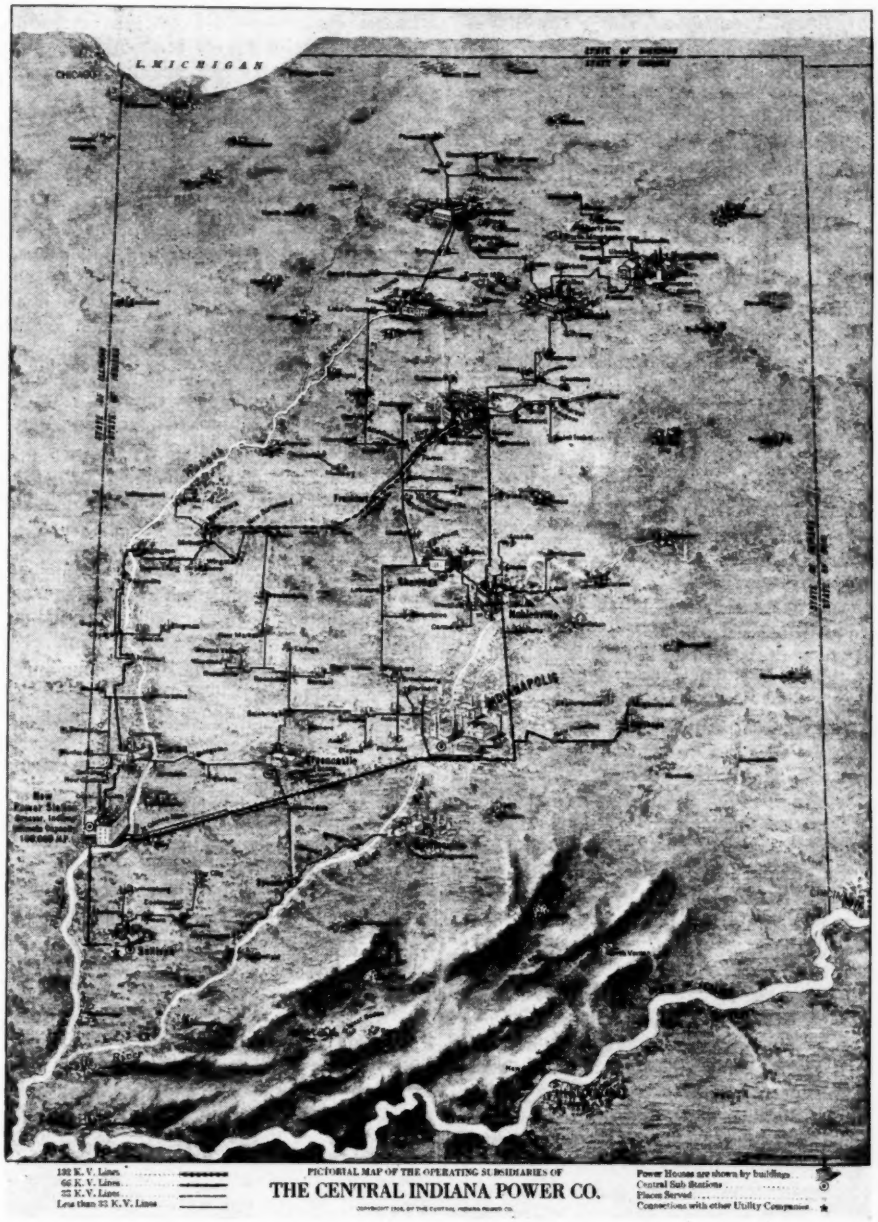
When the Electric Utility Companies were first organized and commenced giving service, electric drive of industrial equipment was not common and the central stations supplied service primarily for lighting and comparatively small motor installations, using principally the Edison 220 Volt direct current system.

The low voltage used for distribution of electricity for lighting purposes resulted in the economical range of distribution being small. The stations were of necessity located close to, or central to the lighting load centers and it is largely from this fact that they were termed central stations and the electric supply business was conducted by what was then known as central station companies.

The character of the business of the early central station companies which sold electricity principally for lighting purposes was such that the time of operating the machinery was fixed primarily by the hours of daylight and darkness and for this reason the money invested in power plant apparatus was in use for only about three hours per day or from dusk to bedtime.

I am stressing the point that when the business of electric supply was in its infancy the money invested in power plants was in use each day during the hours between the passing of daylight and bedtime as the departure from this has an important bearing on the remarkable growth of public utilities as a business. In such lectures to classes of students in engineering as it has been my pleasure to address, I have always endeavored to impress them with the fact that when they had completed their studies and entered the ranks of employment that they would soon have brought to the the realization that the world's definition of the best engineer is the engineer who can make a dollar earn the most money, and a dollar working for only about three hours per day or thereabouts, which corresponds to a capacity factor of only 15 per cent, is not doing its full duty to mankind as a dollar.

Each dollar invested in a public utility enterprise must earn a reward for itself and this reward comes home to the utility



in the form of revenue from the sale of its products.

The most tangible means of securing revenue is the holding of the old business and the obtaining of new business. The management of a utility must of necessity be interested in the revenues earned by furnishing service to the consumer and by the collecting of its rates for such service rendered. For, to use a slang expression, the utility must live off its "Gate Receipts."

The development of high efficiency lamps helped to force many central station managers to give attention to the sale of power. Installation of high efficiency lamps following the calendar year 1900 meant that many stations, which had depended almost wholly upon the sale of

light, found themselves with a rapidly decreasing revenue.

The reorganization, which high efficiency lamps forced in many central electric stations, was comparable to the changes which were brought about in the gas business when electricity was introduced. The gas companies, which had given most of their attention to lighting, discovered that they should turn attention to the sale of gas for industrial purposes and the advent of the high efficiency lamps forced the electric utilities to do likewise.

It is a matter of common knowledge that there has been an enormous expansion in the area and in the number of cities which central stations serve at the present time.

This increase in the range of distance to which electricity could be efficiently and economically transmitted was brought about by the discovery that with two coils of wire properly insulated and placed on magnet iron and that when an alternating current of some certain pressure or voltage caused an electric current to flow through one of the coils that electricity of a higher voltage would be present on the second coil and would cause a corresponding amount of alternating current to flow through the second coil.

That principle, highly perfected and elaborated is used today in a costly and complicated piece of apparatus, known as a "transformer," which with the necessary accessories, is brought into use either to raise or reduce the voltage. It works on the same principle of magnetized iron and coiled wire as does the generating machine, except that there are no moving parts, so that it does not require any steam engine in connection with its use, and it can be used either to raise or lower the voltage of the electricity.

As a result of the development of the alternating current transformer we have progressed from the modest 220 volts direct current that Edison gave us 40 years ago, to such a point, that, in many sections of the country, high tension lines now carry alternating current electricity at five hundred and six hundred times higher a voltage than Edison original 220 volts. That is, we now use 110,000 volts and 132,000 volts, and in some districts even 220,000 volts of electrical pressure.

The change in the light and power business from the 220 volts direct current use, to the use of alternating current at higher voltages, helped to centralize the light and power business because this change made possible efficient transmission of electricity over long distances and facilitated the transformation and distribution at different voltages, which in turn adapted this source of electricity to a very wide variety of uses.

Recent Growth in Industrial Application of Electric Power

It is rather interesting to look at some of the figures of the recent growth in the industrial branch of the business of electric supply.

The last census shows that of the total elctrical energy sold by commercial stations (not including municipal plants) but 18 per cent only was sold for light, a fair portion of which was for small motors and appliances; that over 51 per cent was sold for power, and over 30 per cent was sold "to other public utility companies."

In the stone-quarrying industries, including limestone, granite, sandstone, slate, and marble, there was an increase of horsepower of motors operated by purchased electricity of 416.8 per cent.

Likewise in mining, there has been a marked increase in the amount of electric current purchased, while in most instances, there has been a relative decrease in the amount generated by the various mining enterprises, themselves.

The metal industries as a whole are now purchasing almost as much electrical energy as they are generating.

From the foregoing brief analysis of the light and power industry, it is clear that the tendency in the development of this business is toward the enormous increases in the amount of electricity used for industrial power purposes. Moreover, it is probable that this tendency will be even more marked with the passing of time.

As to the future possibilities of the business probably not more than 60 per cent of the industrial power load is electrically generated today. Probably not more than somewhere between 35 per cent and 40 per cent of the population of the United States live in electrically lighted homes. Scarcely any of our steam railroad mileage is electrified, not over 1 per cent. Probably not more than 12½ per cent to 15 per cent of the 6,000,000 farms of the United States use electricity.

Super-Power Defined

Let us now for a moment look into the future and see what super-power may hold for us in this immediate territory contiguous to Chicago and say, first of all, that this name super-power may carry a

mystery meaning, which must at once be dissolved. It is the furthest from mystery. Indeed, so simple are its principles and applications that we can eliminate the mystery element by saying that ever since our electric utilities went into being they have been practicing the principle for which superpower stands. We have, as a result of the enormous growth of the industrial branch of the business of electrical supply now arrived at a point where the market for electrical power has increased to such a point that it can not be economically supplied by small, inefficient and unassociated stations, and there lies within our means the ability to supply that demand from large, highly efficient and associated stations, and this surely must be done, and in such a procedure we define super-power.
Super-Power.

At least two facts are clear: First, that in super-power is a definite engineering development, which makes its appeal on a sound economic basis. Second, that there is nothing rigid and inflexible in the super-power program; nothing that needs to be pushed into every out-of-the-way corner of the country before its value starts to count. It is a working schedule. In fact, it is already at work as we have the evidence here before us today.

I am a member of the National Electric Light Association committee which has been at work for some time past making a general survey of the Great Lakes District, extending from Milwaukee around the southern end of Lake Michigan to Toledo and south to Springfield, Terre Haute and Indianapolis, and thereby embracing Chicago.

Based upon the belief that the territory eventually will be covered by an interconnected series of super-power systems, and taking into consideration the same rate of progress of business as has taken place in recent years, it is estimated that by 1950, in this territory, the amount of electricity generated will be about four times the present output. The capacity of the plants will increase from 2,000,000 kilowatts to about 5,000,000 kilowatts, or 1½ times. In other words, the capacity factor instead of being 28½ per cent as it is now, will be about 50 per cent.

That means that the money invested in the plants will be in use, on the average, throughout that territory, from 65 per cent to 70 per cent more in 1950 than in 1922.

It should be noted then that in 1950 the dollar will commence to perspire which is proper for the reason that the utility is subject to the same fundamental laws of "economics" as is any business and we are commencing to make the dollar earn a higher rate of interest. For the isolated municipal utility engaged in a state or city where the capacity factor in its generating plant is only 15 per cent, or in other cases 28 per cent and 30 per cent, such utility ought to do its part to get into the 40 per cent or 50 per cent class, that is, such plant should be interconnected with some super-power system as eventually all power plants will be joined together in one vast system or series of systems, and every new completed project will be added to them, forming a tremendous power reservoir from which current will flow into every locality. Each power house or substation and transmission line will be a unit in the complete whole.

Cost of Electric Current Has Dropped

In the last five years for which we have census returns, there was an increase of 25.4 per cent in the hours during which commercial central stations used their plant to maximum capacity; that is the given investment is used more intensively, and consequently, there is found a constant decrease in the investment necessary for each kilowatt-hour sold. We have before us in a very tangible form, the result of the increased use to which the money invested in electric utilities has been put as a result of a study of the economics of energy supply that can be effected by monopoly in production and distribution under intelligent direction. It has to do with the question of prices charged to the consumer in the United States for electric service. Take the necessities only, food costs in the cities have mounted 42 per cent in the last 20 years, housing 62 per cent, clothing 74 per cent, furniture 117 per cent; (these are Government figures). The cost of electric current has actually dropped, notwithstanding the great increase in the cost of labor and cost of fuel, resulting therefrom.

Let us look for a moment at the situation as it existed in Indiana during the calendar year 1920. For the first nine months of the year the average consumption of coal for each kilowatt hour generated was approximately 4.5 lbs. of coal as an average for 25 cities such as Indianapolis, Terre Haute, Fort Wayne, Wabash, Logansport, Kokomo, Marion, Richmond, Anderson, Huntington, New Castle, Lafayette, etc. This electrical current could be generated in a modern plant for

2.25 lbs. of coal thus saving one-half of the coal, this project being one of coal conservation and in the interest of all the people it is interesting to note just what this saving means. During the first nine months of 1920 there was generated an average of approximately 48,000,000 KWH. per month in the districts embodied in the territories served by the 25 aforementioned cities in the central part of the State of Indiana. If we save 2.25 lbs. of coal per KWH. in a modern super-power plant as compared with the local plants in the aforementioned cities we will save this on 48,000,000 KWH. which would be approximately 100,000,000 lbs. of coal or 50,000 tons of coal per month saved. The coal saved each year would be then 600,000 tons.

Lifting a Transportation Burden

If the super-power plant were to be located in the coal fields at the mouth of the mine a great transportation burden would be lifted from the railroads in that the necessary coal cars and locomotive equipment could be used for other purposes. To handle 600,000 tons of coal per years would require 12,000 cars and about 400 locomotives or 400 trains of coal of 30 cars each. If each car requires eight days to make the round trip from mine to consumer and back then we would require for the year's business 308 cars working six days per week.

The super-power development in Indiana makes necessary the bringing into use the proper form of economical power available, namely, steam power. This is brought about on account of the great quantity and distribution of coal in this instance. Coal may be called the standard fuel of Indiana.

Water and Coal

You hear a great deal said about the production of energy at coal mines and of that energy being carried to great centers of population. In this case the idea is to build steam plants, but in order to produce electrical energy economically, you need vast volumes of water and it is the rare exception for any very large amount of good water to be found in the neighborhood of our coal mines. Indiana is particularly fortunate in this respect in that we have here both the water and the coal.

It takes about 500 to 700 tons of water for every ton of coal burned. Most of the large electric power companies in our big cities like New York, Philadelphia, Boston and Chicago, pump more water for use in connection with the production of electrical energy than the city water works in those various cities. Likewise this super-power plant here today is pumping more water than is the City of Indianapolis.

To conserve the coal supply should be the principal aim and object of such an installation of super-power plants and transmission lines as we have here; however, there is no reason why such a project should not represent the very best class of a good investment when properly designed, equipped and operated.

The super-power system permits the full use of natural advantages and reduces the consumption of fuel to a minimum, and where steam plants are required, the units can be of the larger modern type which generate power at the best economies.

Anything that will add to the efficiency of our apparatus, or, to put it in language that will more closely appeal to you anything that will lead to the dollar invested being more continuously in use, will lower amount of capital requirements and at least help offset such increased costs as the utility is subject to, and thus prevent raising the price for the product to the user.

The Investment

We are continuously increasing the supply of electrical energy, raising the voltage and extending the distance of transmission. Super-power systems have passed from the stage of discussion to the state of realization. However, it must be recognized, that as a public utility business expands, new capital must be provided for the necessary additional investments. A business of this kind, if successful, comes into the market for new capital at comparatively frequent intervals in normal times.

As the factor of investment is by far the most difficult in large power development, it is well to examine it with closer attention to detail. If we understand clearly the relation of the investment to the development, we have obtained the first grasp of the problem here under discussion, namely looking into the future and what we can expect.

There are two primary divisions of the investment. The first consists in making the investment to produce the steam which turns the generating machine. To do this, a large power house must be built, tunnels must be dug to mine the coal, conduits installed to carry the condensing water to where the generating machines are placed in power houses, and

much difficult construction of many sorts must be done and machinery provided at an enormous investment.

The second source of investment is that necessary in transmitting the electricity to the consumers. The super-power plants are favorably situated, with reference to the natural advantages, such as coal, condensing water etc., which in virtually all cases, is remote from the cities. The cities of course, are the chief market for electricity; without their demand for electricity it would be financially impossible to develop the super-power system.

Therefore, expensive transmission lines, with great steel supporting towers, and costly transformer-stations, must be built. In some cases it has been found that the investment cost of transmitting the electricity is more than the investment cost of producing it. This varies according to the conditions, length of line and other like factors, and a discussion of certain features of this transmission of electricity are necessary to a proper understanding of the problem.

Transmission

In order to transfer to the waiting markets the great amounts of electricity, after it has been produced by the generating machines of a super-power house, it must be sent over the transmission lines at a very high degree of concentration or "voltage." Two customary pressures are at present used for transmitting great amounts of electricity. They are 110,000 volts and 132,000 volts.

It is plain that such electricity is in too concentrated a form to be used in this condition to operate the apparatus of consumers, such as electric lights, fans and machines, which are adjusted usually to but 110 and 220 volts. The concentrated electricity must be weakened or, as engineers say, "stepped down," in order to reduce the voltage.

In this case of "stepping down" the voltage, the transformer lowers the pressure of the electricity, as it comes from the transmission line and sends it out over distribution lines, so that it can be used on the ordinary electric wiring systems which supply the apparatus of the household or shop.

Transformer Expense

Because it is such an expensive thing, the transformer is especially important to our discussions of investment. In ordinary cases, a transformer needed to reduce the 110,000 volt or 132,000 volt concentrated electricity on the transmission line into a weaker current, useful over the local distribution systems to the homes and factories, would cost several thousands of dollars. That is why it is no easy thing to connect to a transmission line for a small group of consumers.

This makes clear why it is that a high voltage transmission line often traverses territory which it cannot, within the rules of economy, serve with electricity. There must be enough consumers to justify the former and the distribution lines, also the other delicate apparatus needed to supheavy expense of installing the transplement the transformer.

The cost of bringing high voltage electricity on a transmission line in a suitable form to one customer or house, is so great that the individual, except in isolated cases, such as large factories, can not bear it alone. He must share the cost with his neighbors. And where neighbors are few, the cost still remains so high as to be prohibitive.

Using Inter-Connecting Lines

The practical working out of the distribution of the electricity, within the rules of economy, and within the area being served, requires then, in addition to the high voltage transmission lines, which transfer the electricity in bulk to the principal load centers of the market, that inter-connecting lines be used: (1) to transfer energy from one load center to another, in order to take care of small increments of growth in demand of local municipalities and consumers; (2) to provide means by which reserve capacity of centers of distribution in one part of the system may be made available for use in adjacent centers; (3) to equalize the load between the generating plants of the system, or to distribute it among them as economy or policy may direct.

This fact fixes one of the basic principles of the business of a super-power electric supply that is to obtain customers—the more the better. And the electric business is constantly striving for more customers and more markets, and in this way develop, within the area being served, thousands of users of electricity.

The problem of bridging distances within the rules of necessary economy; that is, at a cost which is not too great, when divided among the thousands of users of the service—is the major problem to be solved in developing the super-power system of electric supply, and thereby making electricity available to everyone, everywhere, within the area to be served.

Where interconnected transmission systems are now in use, all but the more iso-

lated localities are today served with electricity at prices within the reach of everyone. In some localities the market is for the moment unprofitable, because the electricity would cost too much to be taken there under present conditions.

But with the growth of the super-power system, with increasing efficiency made possible by new apparatus, with better methods of operation, with new economies in the management, effecting the production and distribution of electricity, all markets will be reached and served.

However, it requires so great an investment, such multiple resources of generation and distribution, to provide a dependable, constant electric service, that formerly, a few people banded together in very small municipalities or power districts, could not afford electric service, but many small systems, interconnected, can be prepared to draw upon some large super-power source to meet any demand for service and meet it economically, the electric service supply becomes a possibility through the ability of the super-power system to both conserve and create.

The Form of Ownership

Such small developments, however, have been given prominence in the municipal ownership discussions of recent years. If the people should insist on municipal ownership, they will deprive themselves of the full benefits of the resources which nature has given us. Therefore, private ownership, under public regulation is not only the better but also the safer method. Power plants should not be permitted to spring up here and there, in accordance with immediate demands, for that means local electrification, and later economic pressure will require eventual abandonment of these local inefficient plants.

One great influence which is always at work in the matter of the increased demand for electric service is the adaptability of the electric motor to all sizes of power units, the ease and small cost of installation, as compared with the cost of individual power plants, the economy of space required, its cleanliness, its instantaneous availability, the absence of noise and the ease of operation, the matter of cleanliness and convenience of electric lights as compared to other forms of illumination.

Some of the Benefits of Super-Power

It is interesting to note some of the benefits to be derived from the development of the super-power system of electric supply, other than just the physical convenience of its use. Super-power will aid in the decentralization of our cities; that is, it tends to distribute the population and to make all parts of the area prosperous, instead of concentrating all industries requiring power into congested areas and leaving agricultural areas without power. The massing of the population, the creation of large centers where manufacturing operatives live, has a very serious effect upon our people, which does not tend to improve either their moral or physical condition.

It is a fair conclusion that we need more electric energy, and that we want it in larger and larger units, and distributed more widely and more effectively than it now is and the realization of the need lies in the super-power system of electric supply. The explanation of this unusual development of the industrial power branch of the business of electric supply is to be found in the advantages which will come to the workman through the centralization of the generation of electrical energy in super-power plants and its distribution over several hundred miles to rural areas, to manufacturing districts, to mining regions, and to cities and towns of every description.

This distribution can and will serve in the industry of electric supply by shifting of electrical energy to the localities where, at the time, there is the most pressing demand for it, the same as our federal reserve banking system serves financial needs.

Unless we are willing to face stagnant conditions in respect to the country's culture and also to a wide range of important industrial developments, the whole matter of our power supply is doubly important. Why? Because ultimately the test of any country's culture is the workman and his job.

The whole movement of American industry, under private initiative, is directed towards providing immense quantities of well-made goods, and at the same time, paying comfortable salaries and wages to self-respecting men. Everywhere the trend on the farm and in the shop is towards electrically operated labor-saving devices which will enable a man to produce more, and therefore, to have more.

There will be no more important factor in our future industrial development than abundant electric supply transmitted in such a way as to distribute industrial opportunity over a far wider field than during the past. We can accomplish this with

electricity for the reason that electricity is bounded only by our knowledge and by its use. Electrical power for practically any purpose can be transmitted on wires at the particular time and to the specific place of using.

Interconnection of various communities into a super-power system of electric supply results in an abundant electric supply, transmitted in such a way as to distribute industrial opportunity over a far wider field than during the past; when you do this it broadens the scope of the industries themselves.

It tends to distribute the population and to make all parts of the country prosperous, instead of concentrating all industries requiring power into congested areas and leaving farming areas without power.

Gradually, as power production moves back closer to its natural sources, what will happen in the next decade, the engineers predict, is an amazing development in the use of electricity not only to move things and to light them, but to split or melt them up and make them over.

Each year sees the process reaching further. Now where sufficient power is available—we see the operating of electric furnaces for steel. Flour, cloth, and leather goods are not complicated arts requiring intricacy in manufacture. Machines supply the skill today. But POWER is the thing needed. We must supply power.

On the farms, in so far as the workman is concerned, the variation in demand for labor runs completely wild. The Federal Employment Service received something like 600 times as many calls for farm hands in June as are filed with it a few months earlier.

There are few figures to show the actual increase in number of men employed on the farms in harvest months as compared with the winter months. But certainly in many sections of the country during harvest season the winter employment figures are multiplied many times.

In clothing trades, shoe factories, and the like, the basic difficulty is a seasonal demand on the part of the consumer. In the building trades it is the lack of substitute employment to fill in valleys of slack work and bad weather. On the farms it is the fact that once a crop is harvested, there is no work in the neighborhood that needs the worker for another twelve months period.

Laws cannot change the minds of purchasers who want spring clothes in spring and fall clothes when the summer ends. Laws cannot stop the rains and frosts that slow up building. Laws cannot make wheat and oranges and cotton grow in the same soil, or ripen so evenly by the calendar that they will furnish steady work for farm labor twelve months in the year. What we need is other jobs to fill the valleys in old ones.

It is not a temporary situation that vanishes with better times. Year after year it goes on unchanged. When the greatest industries in the country, employing many million men, show a percentage of idleness as high as 20, 25, sometimes 35 per cent, it is a substantial tax on capital as the dollar invested is not working. Losing one day's pay in four is a sacrifice to ask of labor.

New Centers of Production

This is the cue for super-power. Put new centers of production within striking distance of crops that need reaping and with an instrument far more effective than theories you attack realistically the problem of seasonal employment and the floating worker.

Initiated as an essential act of evolution by the electrical industry, promising a great expansion to the public service, super-power must not be permitted to become a boomerang.

The very term "super-power" is perhaps misleading and unfortunate. It suggests superintensity rather than a great massing of power resources through the interconnection of existing systems supported by the development of new ones. This must all be made clear to industry, to the press and to the public.

Briefly, super-power is a vast progressive program for developing electric power in quantities hitherto undreamed of. Coal, burned at the mouth of the mines, will produce power wherever there is sufficient water for condensation. Power from many sources will be "tied in" and passed along transmission lines at new voltages which the engineers are beginning to use. Gradually large sections of the whole country will be interlocked with trunk transmission lines of electrical energy ready to be tapped and used by local distribution systems of the communities themselves.

If super-power is to be appreciated by the people and adequately protected against perverted purposes, those who have the practical conception of super-power and its worth must preach the true gospel. It would be no less than a calamity if super-power through misrepresen-

tation were to be misjudged and condemned to obstruction and delay.

What we now must have in the way of assistance to reach our objective, is a settled public policy, uniformly applicable and adopted for the purpose of promoting the general public interest in an entire area. We must have a positive program around which we may rally all those who are honestly seeking development in the same public interest.

As we see it, it is not too much to say that if the real significance of the economics of the supply of electrical energy were understood thoroughly, every thoughtful citizen would be a volunteer business solicitor for the utilities. Electricity supply is a community affair in which all members of the community have a real interest.

In dealing with super-power or interconnected transmission system utility problems, acceptance of its actuality as a whole is the vital thing. This and this only will result in the greatest good to the greatest number and to accomplish this we must avoid a merely local viewpoint; the objective is so great that we must approach it in a big broad-minded way. You must consider that which is necessary to the welfare of the territory served as a whole as well as the necessities of some local community or communities, for in this way only can you assist the utility to fulfill its specific duty to the public in the matter of electric supply.

If we of today have advanced beyond the last generation, it is not because our cities are more crowded or that we have skyscrapers and radio, but because the average man can under present conditions obtain more necessities, comforts and pleasures as the result of his day's work, has far more opportunities for intellectual enjoyment, and lives in accordance with higher standards than his father.

Only one plan for insuring general prosperity to the workman has been found to be universally effective, that is that we do something to increase the productivity of a given amount of human effort, thereby gaining more material things and more leisure to devote to intellectual and moral advancement. The super-power system of electric supply will do this.

In the opinion of the writer, superpower development represents the most important step that can be taken today to accomplish this result and thereby to advance progress and prosperity.

TEN YEARS OF HIGHWAY PROGRESS IN MINNESOTA

(Editor's Note: The following review of ten years of highway development in Minnesota was prepared by Charles A. Forbes and W. P. Chapman for presentation at the 1924 meeting of the Minnesota Surveyors and Engineers' Society.)

The State of Minnesota was organized 66 years ago and in the early days the highway transportation problems were overcome with great difficulty. The highways were merely trails which supposedly followed the lines of least resistance between community centers. If a load could not be hauled with two horses, it was considered more economical to put on four, than to spend much time trying to improve the road.

Until 1913

Until 1913, most of the road improvements were made by the townships. A town board could levy a direct tax for road and bridge purposes and also as much as ten mills payable in labor. Under that law, most of the work done by townships was assessed as labor tax and was worked out by landowners along with the poll tax, which was then in force, which required each able-bodied man to work one to four days on the roads. Each town was divided into road districts, and the pathmaster who was in charge of the district designated where the work was to be done and gave the credit after the proper amount of time had been put in. Usually four or five neighbors were asked to get out on the same day so as to form a crew. If a man had three days with man and team to work out, it was not unusual for him to bring two of his boys with teams so as to get it over with in one day. The equipment commonly consisted of a few slip scrapers, a small walking plow, and possibly a light blade grader which could be pulled with four or six horses.

Bridge Work

The cash portion of the town assets was used largely for the bridges. This was about the only class of work let by contract although some little grading work was contracted. Bridge lettings were almost invariably held at the site, where the town board would meet the several bidders, who in almost every instance bid on plans designed and submitted by themselves. The county surveyor was sometimes called to advise with the board in the capacity of consulting engineer, but after a bridge company

had put up one structure in a community that seemed to be all right, the consulting engineer feature was sometimes considered unnecessary.

State Highway Commission

In 1905 a law was passed providing for a state highway commission of three unsalaried members and a paid secretary, who was the first state engineer, Mr. George W. Cooley. An appropriation of $6,000 was made which had to cover the state engineer's salary of $1,800, all of his help and other department expenses.

The same legislature passed a law providing for a tax of 1/20 of a mill on all taxable property of the state, which, together with the income from the sale of government lands, constituted the state road and bridge fund, which in 1907 amounted to $54,800. This was allotted to the 86 counties of the state, as state aid, and it was then that the first efforts were made to influence counties and towns to adopt a systematic method of procedure in road building so that a connecting system of highways could eventually result.

"Good Roads Day"

The law provided that the third Tuesday in June be designated as Good Roads Day, and this featured prominently in creating enthusiasm for better highways. In a great many communities the people would hold a road bee and oftentimes as many as 100 citizens would turn out armed with picks and shovels, teams and scrapers or any equipment that could be used to advantage, and the day would be spent in improving a bad hill or dangerous curve or possibly surfacing a mucky approach to a village. Roads were commonly hollow in the center or wheel tracks badly worn down, and an effort was made to have the condition corrected by blading so as to produce a crown that would shed water.

Increased Funds

As the number of motor vehicles increased, the demand for better roads became greater, and the efforts and accomplishments of the highway commissions were more thoroughly appreciated. This is evidenced by the fact that in 1911 a law became effective levying ¼ mill for state road and bridge fund, which was 500 per cent increase over the levy made in 1905. In 1913 a still greater advance was made when a law became effective levying a 1 mill tax. The value of adequate and consistent maintenance was recognized at this time and the law required that at least 20 per cent of the fund be used for maintenance. It was also possible under this law to provide an assistant engineer in each county, to be paid by the state, to supervise the state aid expenditures and advise with county and town boards concerning their road problems. The duties of an assistant engineer were practically the same as those of a present county highway engineer. He made all surveys for new construction work, prepared the plans and supervised the construction and maintenance, all for $100 per month, which was the standard salary for the position at that time. The plans were rather primitive in 1914. A standard road plan showed the alignment, profile and grade line, and necessary structures. No curve data was necessary since we always turned square corners at that time. However, the highway department advocated that all turns should have a minimum radius of 70 ft., which was the flattest curve which would clear four-rod fences on a right angle turn. Cross sections were not shown as a rule, except at hilltops or places where more dirt was to be moved than was involved in blading operations. Long stretches on the plan were commonly marked turnpiking. This was estimated by the lineal feet, oftentimes running 2 or 3 cts. per foot. In ordinary country, $300 or $400 per mile was considered a heavy expenditure for grading operations.

County Work

The counties commonly carried on their grading operations by day-labor crews rather than by contract. Most counties purchased tractors and large blade machines and several counties had elevating graders and dump-wagons and camp equipment similar in many respects to a present-day contractor's camp. When a county became loaded with equipment and had several small crews scattered around the county, the bulk of the engineer's time was taken up in buying groceries, hunting labor and providing spare parts for the equipment. Most of the work was graded to a section 20 to 24 ft. wide on top, having a 1-ft. crown at the center.

Gravelling

Considerable gravelling was done also. Gravel was in nearly all cases hauled with teams, loaded by hand and spread by hand, if spread at all. It was dumped in the middle of the road at the rate of 400 to 800 cu. yds. per mile and care was taken not to spread it too much

as there seemed to be a fear that some of it might get into the ditch and be lost. This method is quite a contrast to the present-day method of placing gravel on a flat subgrade, very thin in the center at first with windrows on each shoulder, which are generally pulled in as the center is compacted.

Maintenance in 1914 was quite consistent but a full-time patrolman was very rare. The most common method was to hire a farmer to drag a three or four-mile stretch or less with a small split log or iron drag, only after the rains, and report his time by the hour for actual time worked. The public appreciated good maintenance and when a road was allowed to dry up in a rough condition following a rain, much adverse comment was heard. Various village booster clubs were taking a great interest in good roads and many of them placed temporary signs reading: "If you want good roads, don't drive in the ruts." The motorists in those days had to "get out and get under" to a considerable extent and when the car stopped in ruts the "getting under" was difficult.

Standards for plans and construction methods developed quite rapidly after 1914 and by 1919, when federal aid was available to the counties, nearly every county was letting part of its work, at least, by contract and many had abandoned the old day-labor methods entirely.

State Trunk System

In 1920 the voters of the state adopted an amendment to the constitution providing for a 7,000-mile system of trunk highways to be constructed and maintained directly by the state. The fund for financing this system of highways is derived from a license tax on motor vehicles, and the state highway department took over the construction and maintenance of the system in the spring of 1921. The trunk highway system relieved all counties of a large per cent of their state aid roads but the state aid law was not affected at all, thus leaving counties in a position to designate many more state aid roads to serve as feeder roads to the trunks.

This last great step is by far the most important in the development of Minnesota's road history. The magnitude of the undertaking can be seen when it is noted that the mileage involved is greater than many of the country's most prominent railroad systems and carries four-fifths of the highway tonnage of the state.

Great Changes in Maintenance and Construction

The first move made when the system was taken over by the state was to organize the maintenance department. The state was divided into 16 maintenance districts, with a district maintenance superintendent in charge of each. The entire mileage is maintained by full-time patrolmen, each of whom is assigned approximately six miles of road and held responsible for its condition at all times. In addition to this the maintenance department operates several large tractor and blade reshaping outfits, several gravel screening and loading plants and numerous truck fleets, all of which present a marked contrast with the No. 2 shovel and two-horse drag which was the most prominent equipment ten years ago.

Construction methods have likewise taken great strides during the last ten years. Surveys are made in a very thorough manner so as to consider shortening of routes, elimination of dangerous curvature, steep grades and railroad crossings wherever possible. Cross-sections are taken at 100-ft. intervals and oftener where necessary so that plans can be prepared which will show the yardage which is involved, the kind of material encountered, the amount of overhaul, the number of trees to be cleared and grubbed, details of drainage structures and a great many other items involved in construction. All trunk highway plans are designed for roadway having a minimum width on top of 30 ft., using a flat crown. The sharpest curvature now used on the trunk system is a 20 degree curve, which is a curve having a radius of approximately 290 ft. Grades are designed so as to eliminate as much rise and fall as possible. When one considers the amount of extra gasoline which would be consumed in a year's time on a heavy traffic road by 2,000 vehicles per day going over a 10-ft. rise, it is readily seen that the elimination of the rise is decidedly economical. All construction work on the trunk system is let by contract and the yardage involved in a given project is measured both before and after the work is done and final payment made on the basis of actual quantities moved.

There is a considerable mileage of trunk highways on which the volume of traffic has become so great that paving has been necessary. At the present time Minnesota has 504 miles of hard-surface

pavement on the trunk system, but there is still a large mileage which is in urgent need of paving, since the cost of maintenance of gravel surfacing in many cases greatly exceeds the interest on the cost of a hard-surfaced road.

Roads Not Keeping Up with Vehicles

It is interesting to note that the total expenditure for roads by all units of government, including townships, cities, villages, counties and state in 1913 was $5,286,072, as compared with total expenditure of $25,759,138 for all units in 1923, which is approximately five times as much as was expended annually ten years ago. The number of motor vehicles in Minnesota in 1913 was 42,00, as compared with 455,000 in 1923, which is an increase of approximately ten times. To get at a comparison of the volume of traffic now carried by the highways, it seems safe to estimate that a modern vehicle travels at least ten times as far annually as the early models did, which would indicate that the volume of traffic now carried by the highways is one hundred times as great as ten years ago. However, suppose we be more conservative and estimate the volume of traffic only fifty times as great; this compared with the increase in expenditures of only five times, shows conclusively that we are slipping and not advancing with our construction program as fast as we should in the interest of economy for users of the roads.

SANITATION OF SWIMMING POOLS

By V. M. Ehlers, State Sanitary Engineer, Austin, Texas.

The sanitation of swimming pools, while not the most important subject in the field of sanitary science, is, nevertheless, a most important, and, at the same time, vital subject for our consideration. When we consider the millions of persons who use daily during the summer every available swimming pool and shower in the country, the importance of these institutions becomes only too apparent.

Diseases Contracted in Pools

These pools afford excellent opportunity for the possible infection of millions of bathers. As a source of infection for intestinal diseases, such as typhoid and dysentery; eye and ear infection; for venereal contagion; or for infections of the respiratory system such as grippe, colds, pneumonia, and sinus infections, the swimming pool provides one of the most dangerous sources. And for this reason it is most urgent and necessary that persons having any contagious disease be kept from entering or using these highly contaminable public places.

Regulation Lacking

Swimming pools have so grown in number and popularity during the past decade that innumerable state laws have been enacted and passed regulating and controlling their operation. A great majority of the states have passed and have in operation regulations governing the use and care of swimming pools. These regulations deal with the allowable quality and purity of the water in the pool, with the amount of water necessary per bather, with pre-showers and other prewashing regulations, sterilization of bathing suits and purification of water. These laws give the control of the swimming pools into the hands of the various State Boards of Health, and make compliance with the regulations mandatory and binding upon the various swimming pool operators.

Laws regulating pools after construction are necessary in order to maintain and to insure their proper operation, but still more necessary are regulations governing the actual construction of these pools. Prevention is far safer than any later attempt at remedy.

Essentials of a Good Pool

The two most important factors in any pool are the pool or container itself, and the water contained in that pool. In building the swimming pool care must be exercised in locating it, first, in healthy, sanitary surroundings; and, second, in making it impervious to a possibly polluted exterior water supply or filtration of possibly polluted interior contents to some exterior source. Water-proof cement pools with smooth interiors have proven very satisfactory in actual operation. These pools should be sloped toward one end and have in that lower end a discharge pipe conveniently operated and leading to either the sewer or purification plant. Just above the water level there should be provided a scum gutter and sputum trough to carry off objectionable matter that would otherwise pollute the pool. This trough should be recessed into the side of the walls as to be inaccessible to the hands or fingers of bathers, and it must be sufficiently sloped as to carry off the waste products into the sewer system. The cement walks surrounding the pools

should be so constructed that any water draining from them would flow into a waste gutter and not back into the pool. Proper lighting and a clear, visible bottom will aid materially in cleaning operations. Hand rails, marked depths, and recessed steps should be provided in the interest of safety.

Fill and Draw Plan

If the pool is to be operated on the fill and draw plan, no extra precautions need to be taken with regard to the water other than to be certain of a sufficiently pure supply, ample quantity for each bather, and sufficient regularity in changing the water in the pool. This plan is, of course, expensive since it necessitates the constant waste of large quantities of water.

Continuous Flow

If the pool is to be operated on the continuous flow and filtration plan, it is necessary to provide for the removal of the used water to a filter where its color and impurities will be removed. Subsequent purification of this clarified water can then be accomplished by either chlorination or ultra-violet ray. Specifications usually require a bacteria count not greater than one thousand per cubic centimeter of water in the tank, and the B. Coli count not greater than one per cubic centimeter when grown on agar plates at 37½ degrees Centigrade. Either the ultra-violet ray or chlorination method will give these results. At least 800 gals. per person per bath is required. Hence in constructing the swimming pool provision must be made to provide adequate quantities of water of sufficient purity to meet these minimum requirements.

Other Details of Operation

The details of operation of any swimming pool are essential and vital to the welfare of its patrons. Proper sterilization of bathing suits and towels by laundering after each use is very necessary. Cleaning and disinfection of lockers, halls and walks must no more be neglected than the provision of sanitary drinking fountains, or resuscitation machinery and first-aid kits. Sanitary, private toilets, connected to a safe sewerage system is one of the prime essentials of a safe, clean pool. Wash room wastes from the showers must be disposed of in a sanitary way by connection to the sewers. Pre-showers, both foot and up and down showers, must be insisted upon if the pool is to be maintained in any degree of safety.

Just as in every other public utility, a swimming pool is potentially dangerous in proportion to the number of persons to whom it caters. And since there can be no doubt of the popularity, and no limit set upon the patronage of these pools, it is only too evident that our cities should provide adequate means of protecting those whom it is their duty to protect.

The foregoing address by Mr. Ehlers was delivered at the 1924 convention of the League of Texas Municipalities.

DEVELOPMENT OF BITUMINOUS BASE AND SAND ASPHALT PAVEMENTS

By E. R. Olbrich, National Research Council, Washington, D. C., Formerly Construction Engineer, North Carolina State Highway Commission

The name "sand-asphalt" is obtained from the mixture of sand and asphalt utilized in recent road construction in North Carolina. However, this type of pavement is truly of the black-base or flexible type of pavement, the chief difference from the usual black-base being that no stone is utilized in the pavement either in the base or top.

The ordinary black-base construction using an asphalt concrete base of stone and sand and asphalt has been standardized for some years, and we are all more or less familiar with its construction. Therefore, not much time will be taken in discussing it, except for a few remarks on several important points.

Field for Black-Base Pavements

The black-base type of pavement is ideal for passenger car traffic and pneumatic-tired truck traffic. It will carry any volume of this traffic, but because of its flexible nature is not so well adapted to carry a large volume of heavy solid-tired truck traffic. The writer has observed that under the constant impact of heavily loaded solid-tired trucks a bituminous base pavement, with a 3½ in. base and a 1½ in. top, gradually developed an uneven and wavy surface. Where the volume of solid-tired truck traffic is large, the writer believes that a concrete pavement or concrete base would be best adapted to the traffic.

Given a good subgrade it is possible to increase the depth of the base to 6 ins. or 8 ins. so that the base may absorb greater loads, but this would be economically out of the question on country

roads. Such construction may be economic on heavy traffic city streets, and has the advantage that the pavement on completion may be thrown open to traffic. Cuts in the pavement and repairs are quickly made.

The bituminous base pavement generally cannot compete economically with the cement concrete pavement except where it is possible to utilize local materials. This is due to the fact that it is necessary to heat all the ingredients in the pavement. This requires additional machinery, labor and fuel, and adds considerably to the cost. However, where it is possible to utilize local material—generally sand—it is possible for the bituminous base type to compete with the concrete pavement or concrete base types. In North Carolina the only two bituminous base jobs let to contract were able to underbid the concrete pavement and concrete base types because of the presence of local sand.

Drainage and Subgrade

A bituminous base pavement should not be constructed except where good drainage and a good soil assure a uniform, unyielding subgrade. Any settlement of the subgrade is bound to be reflected in the pavement, resulting in an irregular surface. A subgrade disturbed by frost action will produce failure in the pavement. In this respect a well drained sand soil makes an excellent subgrade, as it is not much disturbed by frost action and affords uniform bearing.

Penetration of Asphalt

The penetration of the asphalt used in mixed bituminous pavement work in North Carolina is from 40 to 50. The writer has for some time felt that the penetration of our mixed asphalt pavements could be dropped an average of ten points or more without danger of brittleness, using a 30-40 penetration in the south and a 40-50 penetration in the north In the case of asphalt macadam pavement a penetration of 60-70 would be suitable in the south and 70-80 in the north.

The work of the Bureau of Public Roads at Arlington in testing the stability of asphalt mixes, has shown that penetration or stiffness of the asphalt is one of the important factors in the stability of the mixed pavements. By stiffening our asphalt in the mix, added assurance against pushing is obtained with little or no additional cost.

Forms

Wooden forms are generally used in bituminous base construction. One of the chief causes of irregular or wavy surfaces in bituminous base pavements is the use of warped wooden forms or wooden forms badly set to line and grade. Where wooden forms are used, 2 in. straight timber, solidly staked to line and grade, should be used and allowed to remain in place, as they will be found to be badly warped and bent if removed.

An experienced form-setting gang should be employed, as too much care cannot be exercised in obtaining a good line and grade of the forms. The wooden forms should not be set too far in advance of the laying of the base, as the action of the sun and rain will soon warp them.

Development of the Sand Asphalt Pavement

The development of the sand-asphalt pavement is a story of adaptation to local conditions and the utilization of local materials. Picture in your mind a sea of sand stretching for hundreds of miles along the coast of North Carolina and for some distance back inland. In many sections this sand is practically clean and free from clay or loam which might act as a binder. This clean, loose sand offers little tractive value to motor vehicles, particularly in dry weather, and offers great resistance to the passage of team drawn vehicles. The driving wheels of a motor vehicle spin in the sand so that it is frequently necessary to go into second or low gear for long distances at a speed of from three to eight miles per hour. There is a stretch of about 40 miles of bad sand between Wilmington and New Bern, North Carolina, through which it takes an average of from five to seven hours to drive. Motorists prefer to make long circuitous trips on the less sandy roads in preference to taking the direct route through the heavy sand. It may be readily appreciated that some type of road surface is necessary to lift this community not "out of the mud" but "out of the sand." An attempt was made to haul in clay to be mixed as a binder with the sand. Owing to the scarcity and long haul of the clay, the cost was prohibitive and the result was unsatisfactory.

Eastern North Carolina is sparsely populated. It contains a number of smaller cities and many small towns, dotted here and there, with large undeveloped sec-

tions in between. At the time of the inauguration of the present road building program there were practically no roads worthy of the name in eastern North Carolina. In order to facilitate the growth of this section it was necessary to construct a main system of good roads connecting the cities and towns and traversing the country between.

The funds available for the construction of this large system of roads, of course, were necessarily limited. Gravel and top-soil are not available in this section for surfacing material. There is no stone, gravel or concrete sand available within a radius of 150 miles. The cost of shipping in sand and stone for construction of a concrete pavement or concrete base would be a very considerable item. In addition, some of these construction projects are from ten to fifteen miles from the nearest railroad, which makes it necessary to haul the cement, sand and stone for concrete construction from the railroad siding to the job by trucks or teams. These factors made the prospective cost of concrete construction run from $3 to $4 per sq. yd. This high cost would reduce materially the mileage of hard surface roads which it would be possible to construct with the funds available. Furthermore, the volume of traffic, except in a few instances, would not warrant the cost of a high type concrete pavement or concrete base construction. The solution of the problem was in the development of some type of hard surface from the only material available—the local sand. Massachusetts, Delaware and Florida had experimented with mixtures of local sand and asphalt for road surfaces. North Carolina has developed the sand-asphalt type of construction until at this time it is well past the experimental stage. About 40 miles of sand-asphalt pavement have been constructed by State forces in North Carolina and a large mileage is under construction at this time either by contract or by State forces. The pavement first constructed has been down for over 1½ years, and has proven very satisfactory.

Use of Local Material Allows More Intensive Construction Program

The speed with which a large highway construction program may be prosecuted in any State, assuming necessary funds are available, depends, in addition to climatic and weather conditions, on two main limiting factors: (1) The number of competent contractors available; (2) the ultimate quantity of road material available and the facilities for transporting these materials.

As long as payments are assured and there is a fair margin of profit in it for the contractor, his number will increase so that this is not the final limiting factor, but no more hard-surfaced roads can be built than we have cement, stone, sand and gravel available for at an economical cost; furthermore, these materials must be moved to the job, and railroad transportation facilities are always taxed during the peak of the construction season. Therefore, the use of 88 per cent of local materials in the construction of a hard-surfaced road, as in the sand-asphalt pavement, makes just that much more cement, sand and gravel available where most needed, and releases a large number of railroad cars for duty elsewhere.

Investigation for Suitable Sand

If it is desired to construct a sand-asphalt surface on any given project or section of road, it is first necessary to determine if there is sand of suitable quality present in sufficient quantities for road construction. The sandy surface of the country is generally underlain by a clay or hard-pan at no great depth, and it is necessary to seek for pockets or pits of clean sand of sufficient depth and area to provide enough sand for perhaps 10 to 15 miles of road.

Grading of the Sand: On the first 10-mile section of sand-asphalt construction in North Carolina, a sand pit was found which gave a sheet asphalt grading. The sand is practically pure silica, clean, hard and fairly angular with a surface worn rather smooth like a beach sand. This smooth surface probably accounts for the fact that the sand will not carry quite as much bitumen as the ordinary river or pit sand found further inland.

SAND GRADING—SAND ASPHALT —PROJECT 379

Pass	Percentage
¼	2.1
10	18.7
40	51.3
80	24.6
200	3.3
Total	100.0

When an investigation was later made for sand for a number of other projects in various sections, it was found that the sand available was similar in all respects to the sand used on the first

project except that it was uniformly much finer, practically all of it passing a 40-mesh sieve.

SAND GRADINGS—SAND ASPHALT

	Project 113B	Project 200B	Project 366	Project 382
Pass	Pct.	Pct.	Pct.	Pct.
40	44.9	28.2	29.5	28.7
10	6.4	2.9	2.3	2.7
60	17.6	19.5	14.7	16.2
80	21.7	31.5	29.2	28.9
100	4.7	13.7	17.5	17.3
150	.8	.8	2.1	1.8
200	3.9	3.4	4.7	4.4
Total	100.0	100.0	100.0	100.0

In order to conform to previous practice and experience in sheet asphalt construction, it would have been necessary to ship in coarser sand from some distance inland to be used with the finer sand to obtain a sheet asphalt grading. This would have materially increased the cost and defeated the purpose of the sand asphalt construction which was the utilization of local materials and low cost construction. The suggestion was then made that a uniform grading be maintained between the 40 and 200 meshes instead of between the 10 and 200 meshes. The work was carried on on this basis and the results have been entirely satisfactory to date.

The use of this fine sand without an admixture of coarse sand represents one of the most important developments in the sand-asphalt pavement and is a radical departure in sheet asphalt construction. It opens up a much wider field for the use of sand-asphalt pavement in that it provides much greater areas in which the local sand may be used.

Subgrade

The material in the subgrade, as is to be expected, is quite generally loose sand. However, outcrops and pockets of clay soil are encountered, and in one instance a project stretched from a section of sandy soil into one with a soil of rather high clay content. In such cases, the practice has been to haul in sand and place it on the clay subgrade for the full width of the grade in order to assure good drainage. It is preferable to scarify and work the sand into the clay, as the clay acts as a binder and gives a more compact subgrade.

An important prerequisite for the success of the sand asphalt pavement is that it shall have a uniform, well-drained subgrade. This is true of any type of pavement, and is a statement so trite that it is axiomatic, but it is of prime importance in the case of the sand-asphalt pavement or any type of black base pavement, as it is a flexible type of surface, and under the action of traffic and temperature will conform to any change or movement in the subgrade resulting in an irregular surface and perhaps failure. Fortunately, sand when confined offers a uniform and well-drained subgrade. It is desirable to keep the grade of the pavement as high as practicable in the low, flat country, particularly where swamps are encountered.

Location of Plant

The ideal set-up for the plant is the case in which the road parallels the railroad and the borrow pit for sand is along the road about midway of the project (i. e., projected highway). It is then possible to ship in asphalt and filler on the plant siding and the stand is hauled from the pit to the plant by slip-teams. It is good policy to set up the plant as near as possible to the borrow pit, so as to reduce the haul of the sand to the heating and drying unit as much as possible. This offers ideal conditions for low cost construction. However, it is sometimes the case that the only available sand pit is located some distance either from the railroad or from the highway, or both.

When the plant set-up is removed from the railroad, the light portable type of asphalt plant is most practical. The capacity of the small portable type of mixer was found to be about 700 sq. yds. of 3 in. base, or 1,400 sq. yds. of 1½ in. surface, per 10-hour day. The asphalt must be hauled in barrels and the filler in sacks to the plant.

Where the plant set-up is removed from the project, it was found necessary to build a driveway or temporary road from the plant to the project over which the trucks could haul the hot mix. It is impossible to get the loaded trucks through the loose sand. A driveway was built on one job, having a width of 10 ft. and using a base mixture 3 ins. deep after compaction, at the rate of $2,500 per mile.

An asphalt storage tank equipped with heating coils should be a part of the plant. It reduces demurrage on tank cars and is assurance against running short of asphalt.

The sand is carried by drag-pans from the borrow pit to the stock pile at the sand drier. The mixing operation is similar to that of the usual mixed types of pavements.

The pavement construction is started at the plant and the construction pro-

ceeds away from the plant so that the hauling of the mix is done over the finished pavement. Therefore, it has been found economical to use light, pneumatic tired, 1-ton trucks for this purpose.

Road Operation

The finished pavement is being constructed either 10 ft. or 16 ft. wide. A very large mileage of sand-asphalt pavement is needed in this sandy country, and funds must be conserved as much as possible in order to stretch them out into the greatest possible mileage. Therefore, in comparatively undeveloped sections, a 10 ft. width has been adopted; whereas, in the more traveled sections near the cities and larger towns, a 16 ft. width is used. If traffic later demands it, and funds are available, it will be a comparatively easy matter to widen the 10 ft. road to 16 or 18 ft.

The grade is built up 30 ft. wide, whether the road is built 10 ft. or 16 ft. wide. It is not practicable to roll the sand fills and subgrade wtih a large tandem or steam roller, and a grooved or ring roller has been utilized to search out soft places and give a uniform subgrade.

The forms are set by a form-setting gang and are left in place after the pavement is completed to act as a protection to the edge of the pavement. After the forms are set, another small gang completes the fine grading. The forms should be solidly staked to line and grade, and the subgrade should be uniformly compacted before the base course is laid.

The base course mixture is delivered at the road at as low temperature as is consistent with proper raking and spreading, as it is necessary to delay the rolling until the base course has cooled sufficiently to permit satisfactorily rolling the loose-raked material on the sand subgrade. The base course is laid to a compacted depth of 3 ins. The rolling of both the base and top course is done with an 8-ton tandem roller.

The surface course mix is laid at a uniformly high temperature of 300 deg. F. to 350 deg. F. to assure a good bond between the base and surface courses. Templates are used in spreading both base and top courses, and the finished surface is checked with a straight edge. The surface course is laid to a compacted depth of 1½ ins.

The average density (i. e., relative solidity) of the base course ranges between 1.85 and 1.95. No filler is used in the base course mix. The average density of the surface course ranges from 1.95 to 2.05, seldom going beyond 2.10. The average densities of sheet asphalt laid on a cement concrete base are slightly higher than these figures, due probably to the fact that there is a certain amount of yielding or flexibility of the black base under the passage of the roller over the newly raked surface course. However, frequent cutting of samples, and its action under traffic, shows the surface course to be an exceedingly tough, dense mix.

A close control of the asphalt mix is kept by a field laboratory in charge of an inspector and by the main laboratory at headquarters.

Shoulders

With a 10-ft. width of pavement it is necessary for vehicles in passing to turn off the pavement with the wheels on the right side of car. On account of the loose sand which composes the shoulder material, this has an element of danger for the thoughtless driver who does not slacken speed in passing. Therefore, every effort is made to encourage the growth of a tough, wiry native grass as a sod on the shoulders. In some places the grass would not take hold, and clay was hauled along the edges of the pavement and mixed with the sand to act as a binder.

Cost of Pavement

Accurate cost records of the sand-asphalt pavement have been kept, and a reproduction of one of the fortnightly or semi-monthly cost reports is given herewith:

NORTH CAROLINA STATE HIGHWAY COMMISSION

Fortnightly Cost Summary Sand Asphalt Operation. District 2. County Carteret. Project No. 200-B. From Oct. 1, 1923 to Oct. 15, 1923.

	Cost per sq. yd.	
Hauling sand to drier	.078	$ 36,190
Labor drying sand	.027	12,425
Fuel oil used drying sand	.131	64,100
Labor mixing	.017	8,200
Asphalt in mix	.300	139,267
Dust in mix	.062	28,918
Fuel for boiler—coal, wood, lubricating oil	.040	18,164
Plant repairs, including plant engineer	.032	14,748
Railroad demurrage on asphalt tank cars	.027	12,700
Rent on asphalt tank cars	.010	4,600
Other plant labor	.076	35,505
Total plant operation	.81	$374,817
Truck drivers' pay roll	.034	$ 15,450
Gasoline and oil for trucks	.046	22,213
Repairs, including mechanic	.011	4,975
Gas, oil and repairs road equipment	.019	9,128
Total hauling to road	.11	$ 51,766

Headers, labor	.028	$ 13,000
Material in headers	.066	30,862
Fine grading, labor	.036	16,660
Laying, raking and rolling hot mix	.108	50,335
Shoulders	.031	15,100
Total road operation	.27	$125,957
Superintendence and time-keeping	.037	$ 17,950
Depreciation, plant equipment	.029	13,722
Depreciation, road equipment	.012	6,161
Interest	.013	6,553
Total incidentals	.09	$ 44,386
Total gross cost		$596,926
Total gross cost, forwarded		$596,926
Deductions (itemize):		
Shoulders		15,100
Total deductions		$ 15,100
Total net cost		$581,826

Performance.

Headers (lin. ft. of road)	2,200
Fine grading (cubic yards) 2,000 lin ft.	240
Shoulders 7 ft. width (lin. ft. of road)	2,760
Base (square yards)	4,889
Wearing surface (square yards)	3,731
Number working days	13
Number days worked, 108 hours	12

Total net cost, $5,818,26.
Cost per square yard, $1.25.
Sq. yds. surface, 4,655.0.
Total No. sq. yards laid to date, 37,884.0.
Percentage of total, 26.6.
Average cost per sq. yd. to date, $1.38.

This report was made up so as to give the cost of (1) the plant operation, (2) hauling the mix, and (3) the road operation. Any work not directly chargeable to pavement operation, such as clearing and grubbing, extra heavy fine grading, special drainage provisions, etc., is separated as "Extra Work."

The cost of the first 10 miles of sand-asphalt finished was $1.37 per sq. yd. without the shoulder work. This figure includes allowance for interest, depreciation and overhead. The shoulder cost was about 10 cts. per sq. yd., or about $700 per mile. Of four jobs now in operation, the average cost to date varies from $1.30 to $1.80 per sq. yd.

The total cost of plant, camp, hauling and road equipment, and accessories necessary properly to outfit a job of this kind, is from $22,000 to $25,000. Of this about $12,000 is cost of plant equipment and accessories. If a larger type of plant is used, and larger trucks, the total cost may greatly exceed this figure.

Conclusion

The sand-asphalt pavement properly constructed on a uniform subgrade will carry an unlimited volume of passenger car traffic and pneumatic-tired trucks. It is ideal for this type of traffic. If the volume of solid-tired heavy truck traffic ever becomes large on any of these roads, then it will doubtless be economy to build a cement concrete pavement or base; but in the meantime, the sand-asphalt pavement will have rendered many years of service at a low cost.

The sand-asphalt pavement has great possibilities of development, wherever unlimited local sand is available—along the Atlantic and Gulf Coast, in some of the lake states, and in the desert sections of the western states.

The sand-asphalt pavement is a development of practical highway research. The need of a community for economical highway service was met by the utilization of local materials. The three essentials of practical highway research are:

(1) Recognition and understanding of the problem.

(2) Solution of the problem.

(3) Placing of the information obtained in the hands of those to whom it may be of value.

The purpose of the Advisory Board on Highway Research, with which the writer is now associated, is to bring together the various agencies active in the investigation of problems in highway engineering and transport in order that they may correlate the results of investigations already made, and to make plans for a program of research of urgent highway problems. Each organization will then concentrate its efforts on research along lines for which it is peculiarly adapted. The results can then be translated and published in a form suitable to the highway engineering and transport field at large. The Advisory Board will act as an exchange to disseminate information and data obtained in the field of highway research.

The foregoing paper by Mr. Olbrich was presented at the recent annual meeting of the American Road Builders' Association.

HIGHWAY TRANSPORTATION SURVEYS IN MAINE AND ILLINOIS

Two highway transportation surveys similar in nature and scope to the survey now in progress in Pennsylvania have recently been started, says "Public Roads" for August, 1924. A state-wide survey in Maine conducted by the Bureau of Public Roads in co-operation with the State Highway Commission was begun on June

30 and will continue for a period of four months. Data similar in nature to the information being obtained in Pennsylvania are being recorded at 95 observation stations so located as to secure traffic data on all important highways in the State. At 20 stations complete weight information on all motor trucks, as well as complete information on all other types of traffic, is being recorded, the weight information being obtained by the use of portable scales. At the remaining 75 stations complete data, except weights, are being recorded on all types of traffic. Data at all stations are being recorded in such a manner that weights secured at the weighing stations can be imputed to traffic at stations which have no weighing facilities.

Observations are recorded by personnel specially trained for the purpose and organized into parties, each having a certain number of stations to operate. The schedules of these parties are so arranged as to obtain complete information on each station at all hours of the day and night and on each day of the week. Two parties are organized to operate the weight stations, five parties to operate recording stations (stations that do not have weighing facilities) and two parties to operate selected stations during the night hours.

The survey in Cook County, Ill., which is being conducted in co-operation with the Cook County Department of Highways began on July 7, and will also operate for a period of four months. This survey is similar in purpose and scope to the Pennsylvania and Maine surveys with such modifications as are necessary to provide the data required to solve the special problems of highway development in an area contiguous to a large city. Data will be recorded at 73 stations in Cook County supplemented by 14 stations located within the city of Chicago.

At 17 of the stations in Cook County complete weight information is being recorded on all motor trucks, weights being obtained by the use of portable scales and complete data on all other types of traffic. At the remaining 56 stations complete data with the exception of weight information are being recorded on all types of vehicles. Information is recorded in such a manner that weights obtained at weighing stations can be imputed to the traffic observed at recording stations. At the stations located within the city of Chicago the density of various types of traffic is being recorded.

Approximately 30 men divided into nine parties are employed in recording data. Two parties have been organized to operate 17 weight stations, four parties to operate 56 recording stations, one party to operate the stations located within the city of Chicago, and two parties to operate selected stations during the night hours. The schedule of these parties is so arranged as to obtain complete records of traffic at each station at all hours of the day and night and on each day of the week.

Investigations are also being made of the effect of traffic density upon the speed of traffic; of the effect of curves, railway crossings, and highway intersections upon traffic congestion; and of the effect of traffic density upon the point of application of wheel loads with reference to the edge of the pavement and the shoulders of the roadway.

A special investigation of motor trucking in the Chicago area is also being conducted. This investigation will include a study of the extent and nature of motor trucking in this area, the organization and operating methods of trucking companies, trucking rates, operating costs, the use of motor trucks in terminal areas, suburban and intercity transportation of freight by motor truck, the nature and extent of competition between highway transportation and rail and water transportation of freight and passengers, and of marketing by motor truck. This study is being made by special investigators who will interview truckers and shipper throughout the area and gather data on this problem from all available sources.

FEATURES OF THE NEW STREET LIGHTING SYSTEM AT NORWOOD, O.

By L. A. S. Wood, Manager, Street Lighting Section, Westinghouse Electric & Mfg. Co., South Bend, Ind.

An interesting street-lighting system was recently installed at Norwood, Ohio, a municipality adjoining Cincinnati, which possesses several new features.

The first section of this installation consists of 120 ornamental cast iron posts of a design which has been adopted as the standard for all new ornamental street-lighting systems for Greater Cincinnati. The posts are spaced 80 ft. apart and are of such height as to bring

the light center 12 ft., 8 in. above the sidewalk. The lamps used are 6,000-lumen, 20-ampere, Mazda C, and in order to insure perfect safety, they are operated from the secondary side of a transformer located in the base of the post. This arrangement permits of a low voltage circuit independent from the underground series system to be used in the post itself.

The glassware is unique in design, and was developed specially for Cincinnati by local engineers, in conjunction with the engineers of the Westinghouse Electric & Manufacturing Company. It consists of two parts—a globe and canopy—both of Monax diffusing glass which presents a pleasing appearance and has roused much favorable comment.

The globe and canopy are assembled as one unit by an ornamental metal band, and the canopy is arranged with a watershed so designed as to permit the rain to drip from the canopy instead of running down the globe as in other types. This water drip feature completely eliminates the streaks which are apparent after a rain storm with other types of globes. The method of assembling the globe and canopy with an ornamental band eliminates shadows which are cast on the globe when internal metallic attachments are used.

DAY VIEW OF NEW STREET LIGHTING INSTALLATION, MONTGOMERY AVE., NORWOOD, OHIO.

NIGHT VIEW OF NEW STREET LIGHTING AT NORWOOD, OHIO.

A new globe-holder known as the "Jiffy"

globe-holder, manufactured by the Westinghouse Company, is used in this installation to attach the globes to the casing. This globe-holder facilitates the removal of the globe for cleaning and re-lamping and reduces the danger of breakage in handling.

The new lighting system was sponsored by the Retail Merchants & Manufacturers Association of Norwood, and the installation was turned on by the Mayor of Norwood, Louis H. Nolte, at the opening of the Annual Spring Festival and Industrial Exhibit.

ELASTICITY OF THE ACTIVATED SLUDGE PROCESS

By Joshua Bolton, Manager of Sewage Works, Bury, Lancaster, England

It has generally been supposed that the activated sludge process is not of an elastic nature, and that great care, constant agitation and aeration is essential. An unavoidable stoppage of power to our 50,000 gals. unit gave rather startling evidence and demonstrated factors which I had not previously realized. Before dealing with our experience, a description of the plant in use would not be out of place.

The plant installed is the "Simplex" aeration process made by the Ames Crosta Sanitary Engineering Company, Limited, Nottingham.

The "Simplex" Plant at Bury

The plant consists of a tank 18 ft. deep, 24 ft. diameter. The bottom is cone-shaped at an angle of 37½ deg., increased to 60 deg. at a distance of 2 ft. from the circumference of the tank. A light vertical tube 3 ft. in diameter is fixed in the center of the tank, resting on feet 6 in. from the bottom of the tank, thus giving a free access for the mixture of activated sludge and sewage to enter the bottom of the tube and pass up to the top. At the top of the tube a revolving cone 6 ft. in diameter is suspended, with an opening 3 ft. in diameter to correspond with the diameter of the vertical tube. This revolving cone is fitted with suitable vanes, and is suspended from a vertical shaft mounted on ball bearings and driven by suitable gearing. When the cone is set in motion, the liquid is thrown out in film formation, and as the film of liquid strikes the surface of the liquid in the main body of the tank, millions of bubbles are formed and the agitation is sufficent to thoroughly aerate the liquid, which, of course, is a mixture of activated sludge and sewage. As the liquid is thrown out from the revolving cone, the liquid from the bottom of the tank rushes up the central tube, and thus a constant and thorough circulation is obtained. The liquid which is thrown out from the cone strikes the surface of the main body of liquid and gives an impetus to it which creates a spiral motion in the tanks, the spiral descent insuring a thorough contact between the sludge and sewage.

A novel arrangement is provided by the construction of a thin shell wall which divides the tank into two compartments, an inner circle and an outer ring. The shell wall protrudes above the surface of the liquid, but terminates about 4 ft. from the bottom of the tank. This shell wall divides the tank into two compartments, the innter circle being the agitating area, and the outer ring being the quiescent or settling area. The distance between the outside wall of the tank and the shell wall can be so arranged as to give the desired ratio of settling area to agitating area.

A sill is fixed at the outside of the settling area, over which the purified effluent passes.

The ascending velocity of the water in the settling area is less than the descending velocity of the sludge; and the sludge settles down and passes automatically into the aerating area to be recirculated.

A draw-off pipe is fixed in the side of the tank, the outlet being about 2 ft. below the surface of the tank, the pipe being led to the bottom of the tank on the inside to permit excess sludge to be drawn off from time to time.

The tank works continuously during ordinary times with a loss of head not exceeding 3 ins., and no power is expended on pumping return sludge. It is found advantageous to stop the tank for a short period before any surplus sludge is drawn off, as this allows the sludge to settle and become more dense, thus obviating drawing off a too watery sludge.

Three Years' Working

The plant at Bury has been in operation over three years, and during the first 18 months it gave good results, but occasionally there was a falling off in the results when various trade wastes from the gasworks and fellmongers came down the sewers. The circulation at this

TABLE I—SUMMARY OF RESULTS WHILE PLANT WAS SHUT DOWN EIGHT HOURS PER DAY.

Quantities stated in parts per 100,000.

	Crude sewage.			Effluent.		
Oxygen absorbed.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
4 hours' test	12.00	1.88	6.40	1.20	0.53	0.80
Ammonias.						
Free from saline	3.10	1.85	2.27	1.88	0.63	1.24
Albuminoid	2.44	0.31	0.73	0.14	0.07	0.10
Nitric nitrogen	—	—	—	0.63	0.29	0.43
Dissolved oxygen taken up in five days	—	—	—	0.42	0.50	0.94

Purifications.

	Per cent. Highest.	Per cent. Lowest.	Per cent. Average.
Oxygen absorbed.			
4 hours' test	95.5	61.3	87.5
Ammonias.			
Free and saline	82.0	13.0	45.4
Albuminoid	93.1	66.6	86.3

Duration eleven weeks.

period was at the lowest point, the power used being only 12-h.p. per million gals. treated. The circulation and aeration had to be increased, increasing the power to 18 to 20-h.p. per million gals. treated, and while using this power the results have been constantly brilliant and trade wastes have given no trouble.

Owing to circumstances over which we had no control, our power supply was shut off for a period of four days, and we had grave anxieties as to what would happen to the sludge. The water in the aerating area and settling area remained brilliantly clear, and when the power was available after four days' stoppage, the plant was put in motion and the contents circulated for three hours. A little odor was noticed at the start, but this rapidly disappeared. Sewage was turned into the tank and good results obtained immediately. From later experience I am of opinion that the sewage could have been turned on at once without the three hours' circulation and aeration and good results obtained.

The activated sludge process is now well established, and its advantage over other methods lies in the economic factor. Each reduction in the power factor is of importance, the more the power can be reduced the greater is the advantage over other systems.

One of the points that have struck me as wasteful in power has been the constant working of the machines during periods of low night flows. Our experience having shown that a lengthy stoppage did not jeopardize the process, I arranged to have one of our tanks shut off for a period of eight hours each night. The results, instead of deteriorating, were actually better.

The table of analyses gives the results over a period of 11 weeks, the flow being stopped and also the machinery for a period of eight hours each evening. The flow to one unit was increased to take the sewage which was shut off from the other unit.

The fact of the effluent being better led me to conduct experiments with simple contact with activated sludge and sewage. In these experiments samples of crude sewage were taken and placed in a vessel containing 15 per cent by volume of activated sludge in an active condition. The vessel was tilted a few times so as to thoroughly mix the liquid and sludge, then the vessel was allowed to stand one hour to enable the sludge to settle. From the table of analyses it will be seen that a remarkable purification takes place by simply mixing the sludge and sewage together without aeration or agitation other than what was necessary to distribute the sludge in the sewage. When a tank is in operation and the power is shut off, the suspended sludge gradually settles to the bottom and is doing effective work during the whole of its travel down through the liquid in the tank.

So satisfactory were the results obtained while the tank was stopped each night that I was inclined to think that purification might take place when the sewage was in contact with active sludge even without aeration or agitation. To test this theory samples of sewage were placed in a vessel and 15 per cent of active sludge was passed slowly down a tube to the bottom of the vessel so as not to create a disturbance or allow bubbles of air to enter. The vessel was allowed to stand undisturbed for eight hours, and the supernatant water was then decanted off for analysis.

TABLE II—OXYGEN ABSORBED, 4 HOURS' TEST.

Quantities stated in parts per 100,000.

	Crude sewage	Effluent.	Purification. Per cent.
Highest	9.20	4.60	77.0
Lowest	3.50	1.31	50.0
Average	5.40	2.15	60.2

Period of test 2 weeks.

TABLE III—OXYGEN ABSORBED.
4 HOURS' TEST.
Quantities stated in parts per 100,000.

	Crude sewage	Effluent.	Purification. Per cent.
Highest	7.40	3.93	68.9
Lowest	1.83	0.80	45.3
Average	4.60	1.81	60.6

Duration of test 3 weeks.

TABLE IV—OXYGEN ABSORBED.
4 HOURS' TEST.
Quantities stated in parts per 100,000.

	Crude sewage	Effluent.	Purification. Per cent.
Highest	12.00	4.43	78.2
Lowest	2.85	1.10	55.2
Average	6.56	2.26	65.5

Period of test 2 weeks.

TABLE V—OXYGEN ABSORBED.
4 HOURS' TEST.
Quantities stated in parts per 100,000.

	Crude sewage	Effluent.	Purification. Per cent.
Highest	11.10	1.33	91.8
Lowest	4.10	0.67	70.1
Average	7.78	1.11	85.6

Period of test 6 weeks.

Table 3 gives the summary of the results, and here again some remarkable evidence is obtained, for it shows that when a tank is stopped and after the sludge has settled to the bottom purification is still taking place.

A further set of experiments were carried out, giving a gentle agitation of active sludge and sewage for a period of one hour, and the results are given in Table 4.

The Birmingham school had previously done valuable work on these lines, and our experiments were carried out to see what effect this method had on the Bury sewage. Our results confirmed the Birmingham views; and for a town where percolating beds are already constructed, and where it is desired to lessen the work on the beds and give greater efficiency, this short period of aeration offers great possibilities. The subsequent settling and reaeration of sludge adds a little complication.

A useful comparison may be made between chemical precipitation and short period aeration. When compared with efficient chemical precipitation, the results from short-period aeration are infinitely better and much cheaper.

On one occasion while the surplus sludge was being drawn off from the tank, a mistake was made and an excessive amount of sludge was drawn off, which reduced the quantity in the tank to below 5 per cent. Instead of the results going off, as we naturally expected, they remained constant and the plant was worked for a period of six weeks with 5 per cent of sludge; and from Table 5 it will be seen that the results were constantly satisfactory.

The volume of sludge that can be used has a wide range, and volumes from 5 per cent to 40 per cent have been used wtih good results; but the most satisfactory volume for the Bury sewage is from 10 per cent to 15 per cent. In cases where short periods of aeration are adopted and the sludge reaerated, the economy effected by the smaller volume of sludge to be aerated must be considerable.

A further experiment was conducted to ascertain how long sludge could be kept without aeration before it became foul. A sample of sludge in an active condition was mixed with a sample of sewage and allowed to stand for 24 hours. The supernatant liquid was then decanted off and another sample of sewage was put on and gently mixed so as to avoid aeration. The procedure was repeated daily, and it was six days before the sludge was developed as an offensive odor, and it will be seen from the table that considerable purification took place daily.

These experiments were carried out, not with the idea of scientific research, but to see how the process would behave under rough usage. Small authorities will not be able to pay for highly trained managers, and it is probable that non-technical men may be in charge of small works and the care bestowed not all that could be desired.

I think the experiments have demonstrated that the process is very elastic and will stand shocks, which ought not to, but may be applied to it.

The foregoing paper by Mr. Bolton was presented at the recent International Conference on Sanitary Engineering recently held at London, England.

TABLE VI—OXYGEN ABSORBED—4 HOURS' TEST.
(Quantities stated in parts per 100,000.)

	Crude sewage	Effluent.	Purification Per cent.	Remarks.
1 day	6.00	2.57	57.1	No odor
2 days	6.00	2.71	54.7	No odor
3 days	6.80	3.50	48.5	No odor
4 days	8.00	3.36	58.0	No odor
5 days	8.20	3.57	56.5	Slight offensive odor

RECONSTRUCTING OLD BRICK PAVEMENT AT BUTLER, PA.

By Fred M. Harper, City Engineer, Butler, Pennsylvania

This article describes some repaving done on North Main street in the city of Butler, Pennsylvania, by day labor, and under the direction of the engineering department, during the summer of 1923.

This street is a part of the paved highway leading from Pittsburgh to Erie, Cleveland and Buffalo, and is subject to very heavy traffic. I feel safe in saying that during the summer months we have an average of 200 cars per hour 10 hours per day, and have been informed by the police that it has reached 800 cars per hour on holidays and Sundays.

The above mentioned street was constructed during the years of 1891 and 1892 under specifications which called for 9 ins. of natural stone base, 1-in. of sand cushion, natural sand stone curb, subdrained by 6-ins. of crushed stone, vitrified wire-cut brick and pitch filler. As I was quite young when this work was done, I am not familiar with the construction of this pavement, but have since learned from men who worked on the street that the stone used in the base was strippings from a stone quarry, where the curbing was procured, therefore contained quite an amount of loam; also that the sand used for the bed or cushion was obtained from the crusher or local creeks and it also contained a great deal of loam. In place of using 1-in. of sand, as called for in the specification, they used as much as 2 to 3½-ins. which was revealed when we removed the brick.

During the winter of 1923 we had continuous rain for about a week, which ended by the temperature dropping to zero in 24 hours. This cold continued for about four weeks during February, driving the frost down through the base of the street into the sub-drain, all of which was saturated with water. About March 1 the weather condition changed suddenly, causing a surface thaw and freezing water held in the 3-in. loam cushion. As the sub-drainage was closed by the frost, the water could not be carried away from the loamy foundation. This converted it into a slippery muck. Traffic caused it to up-heave. As the weather conditions were not favorable for permanent repair, the brick were removed and the holes filled with fine slag, in order to keep the street open. This condition did not exist the entire length or width of the street, but was at intervals so close that from an economic standpoint it required repaving.

On examination I was surprised to find that the brick were not worn to any great extent, notwithstanding their 32 years of use, so it was decided to use the best of them in the reconstruction work.

The labor conditions in the spring were quite serious, therefore the question of cleaning the old brick had to be considered. To overcome this I contracted the school boys during the summer vacation to do this cleaning at the rate of $5 per thousand for removing, cleaning and piling the brick along the curb. I might state that this worked out very well, giving employment to the boys who made from $2 to $3 per day, and saving the city from $3 to $4 per thousand.

The old sand cushion was removed by means of a road machine and tractor, leaving the crushed stone base. This was replaced and brought up to the proper height with crushed slag and the use of a template. It was then thoroughly rolled with an 8-ton roller, which settled it about ½ in. to 1 in., on which was placed ⅝ in. of dust limestone or slag screenings to form the bed for the brick. The brick were then turned, laid, rolled and pitched in the usual way, forming as smooth a surface as though we had used new brick.

On completion, the measurements showed that we had removed 4,713 sq. yds., of which 4,083 yds. were relaid with old brick which had been in use for 32 years, at a cost of $1.26 per sq. yd., and 630 sq. yds. of new repressed block at $2.75 per sq. yd., both prices including pitch filler.

The foregoing method of construction, as recommended by the Engineering Department, saved the city about $12,000. A new job from the ground up would have cost $4.05 per sq. yd.

The work as completed, after having sustained the abnormal traffic of the fall of 1923 and several freezes and thaws of the winter of 1923 and 1924, has all the appearances of being a quality equal to new construction.

PRINCIPLES AND PRACTICES IN COMMON CARRIER MOTOR VEHICLE REGULATION

By Henry R. Trumbower, Economist, U. S. Bureau of Public Roads, Washington, D. C.

(Editor's Note: This admirable summary of principles and practices now in vogue in various states in the regulation of the common carrier motor vehicle with its numerous references to court and commission rulings, was prepared by Mr. Trumbower for the August, 1924, number of Public Roads, issued by the U. S. Bureau of Public Roads. This is a subject to which engineers and engineering journals have given but little attention, despite its close relationship to the economics of public highway development. It is a most interesting study. Many of the accepted usages in regulating the ordinary run of utilities do not fit the common carrier motor vehicle situation at all. Few intellectual exercises are more stimulating than the exposure of the bad fit that results when some of the old theories of regulation, rate making, etc., are forcibly applied to this new public utility. A new philosophy is being developed and, while some progress has been made there is still plenty of time for any one to catch up and grow up with this developing subject.)

In 1907, about the time when automobiles began to come into general use, the States were still debating whether public service corporation furnishing light, heat, power, water and telephone service and the traction lines should be placed under the regulation of the States by public utility commissions. By that time most of the States had established railroad commissions which regulated the rates and service of steam railroads and there was a general feeling that these other public utility enterprises should be similarly regulated both as to rates and service. Wisconsin and New York were the first states to extend this jurisdiction of the State and both enacted laws which gave these regulatory powers to railroad commissions which already existed.

When the automobile began to be used as a common carrier, either as a jitney competing with city street-car service or as a bus between cities or as a truck carrying persons and property for compensation, it was recognized that this was a new type of public service. Cities first began regulating these new transportation agencies and subsequently State legislatures began passing laws which extended their jurisdiction and regulatory power to the motor vehicle operated as a common carrier in like manner as to the rail transportation service. There has been considerable discussion as to the policy of extending a State's regulatory power to the motor vehicle. As yet there is no complete agreement on the subject and not all States have gone so far as to regulate common carrier motor vehicles to the same degree as steam and electric railroads.

Arguments in Favor of Regulation

The principal arguments in favor of State regulation of automobile carriers may be summarized as follows: That motor vehicles operating as common carriers should be regulated the same as other public transportation agencies and in that manner travelers and the shipping public would be assured regular, adequate, and efficient service including at the same time the highest degree of safety and responsibility; that where motor vehicle common carriers are apt to bring about competitive conditions which are ruinous to other carriers, the State can determine what is to the best interest of the public in the long run and protect that agency which it is shown deserves protection and whose service is needed by the public; that there should be placed upon the common carrier motor vehicle those duties and obligations which are commensurate with the benefits obtained from the public which furnishes the highways and allows it to be used for gain and profit; that public regulation is desirable in order to protect from irresponsible competitors those motor vehicle common carriers which have established themselves and are furnishing satisfactory service.

Is Regulation Necessary in Absence of Monopoly?

The attitude of those opposing this type of legislation finds its expression in the message of the governor accompanying the veto of a motor-vehicle regulation measure passed by the Wisconsin Legislature. He said: "My objection to this bill is fundamental. Jitneys and buses may be operated by anyone upon the public highways and streets, and therefore there is no opportunity to create a monopoly. Free competition prevails, and thus rates and services are regulated by the natural law of competition. It is quite different with respect to a street railway, an interurban railway, or a railroad. When either of those occupies a

territory, there is no opportunity for a competitive, like system to come into that territory. There is a limitation on the number of street railways or interurban lines that may occupy the field of transportation, and so the transportation companies hold the field against all others; and the reason for regulating them is because of the fact that they possess a monopoly, affording them the right, in the absence of regulation, to arbitrarily discriminate, grant rebates and other special favors, charge an excessive fare, and give inadequate service. The legislature, therefore, wisely provided for the regulation of such monopolies. The motor vehicles have come to stay; they are the beginning of a transportation system about which it is dangerous to prophesy. They may in the future be displaced by more modern systems of transportation. The old canal companies fought for their existence when the railroads came, but the building of railroads could not be obstructed merely for the purpose of preserving the canal companies. * * * I do not believe that it is any part of the State's duty to obstruct or hinder that means of conveyance. So long as the motor vehicles do not possess a monopoly, there is no ground for regulating them, except to protect the safety and health of the traveling public. To regulate them from the standpoint of protecting some other business, is to interfere with free competition, not in the interests of the general public, but for the special protection of some specific business."

There is a certain amount of truth in the statement that public regulation is not necessary where monopoly conditions do not prevail. Regulation on the part of the Federal Government and the State governments was undertaken for the purpose of protecting the public against unreasonable rates and discriminatory practices which grew up under monopoly conditions. It seems, therefore, logical that when and if competitive conditions are restored regulation can be given up. In this connection it should, however, be observed that the motor vehicle as a common carrier makes its appearance as a competitor in the entire field of transportation, including steam railroads and electric city and interurban railroads. To keep on regulating one form of transportation as to rates and service and allow the new type of competitor free rein without placing upon him any degree of restraint or responsibility is an unfair practice and will lead sooner or later to conditions which will be intolerable from the public point of view. The public is entitled to adequate and continuous service at reasonable rates; unlimited competition on the part of the motor vehicle with the common carrier which is regulated by the public will in the long run seriously affect the service and may force that type of carrier to curtail or abandon its service which is most essential to public needs.

Motor Vehicle Common Carriers Regulated in 28 States

At the end of 1923 there were 28 States[1] which had adopted the definite policy of regulating motor vehicles engaged in common carrier service and through the State public service commissions were exercising control over the routes, service, and fares. Many of the cities exercise control over so-called jitney operation even though the State has not enacted any legislation pertaining to motor vehicle common carrier service on the public highways. There are also certain States which have not gone so far as to put automobiles carrying passengers and freight for hire into the public utility class which at the same time require such operators to carry liability insurance and give bonds. As yet the Federal Government has not taken any steps to regulate automobile carriers although there are a great many who engage in interstate business. Where railroad companies have made arrangements to forward freight shipments by rail and motor truck the Interstate Commerce Commission has taken the position that the commission's jurisdiction does not extend to that part of the service carried on by motor truck over the highways.

The right of the State to regulate the activities of motor vehicles engaged in common carrier operation is well established; this is true whether the State does it directly through a regulating commission or through a city council which derives its powers from a charter granted by the State. The regulation and control of the jitney has been held by the courts to be a legitimate exercise of the police power. *Memphis* v. *State ex rel Ryals.*, 133 Tenn. 83; *Ex parte* Dickey, 76 W Va. 576; *Auto Transit Co.* v. *Fort Worth (Texas)*, 182 S. W. 685; *Thielke* v. *Albee*, 79 Ore. 48; *Huston* v. *Des Moines*, 176 Iowa 455; *Green* v. *San Antonio (Texas)*, 178 S. W. 6; *Smith* v. *Nunnelly* (*W. Va.*) *P. U. R.*, 1915E 177. Under the police power of a State the legislature may prescribe the number, charter, routes, rates,

and hours of service of common carrier vehicles on highways; this power can be delegated to a city council or to a public service commission.

In framing laws of this character it is necessary in the first place to name and describe definitely the type of motor vehicle and the nature of the service which is to be regulated and supervised by the State. The State of Washington has adopted a very comprehensive definition covering this matter; its jurisdiction extends over all "auto transportation companies" and these are defined as "every corporation or person, * * * owning, controlling, operating, or managing any motor propelled vehicle not usually operated on or over rails used in the business of transporting persons, or property for compensation over any public highway in this State between fixed termini or over a regular route, and not operated exclusively within the incorporated limits of any city or town; Provided, that the term auto transportation company, as used in this act, shall not include corporations or persons * * * in so far as they own, control, operate, or manage taxicabs, hotel buses, school buses, motor propelled vehicles, operated exclusively in transporting agricultural, horticultural, or dairy or other form of products from the point of production to the market."[2]

One of the frequent questions which commissions and courts have to decide is whether or not a specific motor vehicle is operated in such a manner so as to bring it within the State's regulatory powers. Statutory definitions which are clear and comprehensive are of great assistance to those who are responsible for the administration of the law. That the State has the power to regulate common carriers is no longer open to argument, but a commission can regulate only those common carriers which have been definitely named and included by definition in the statute conferring jurisdiction to the regulatory agency.

An example of this came up in California. The California commission held that a motor bus line, auto truck line, or auto stage line engaged in transportation for hire was not a public utility under the California act although it might be a common carrier. *Western Assoc.* v. *Hackett (Calif.)* P. U. R., 1915F. 997. The position taken by the commission was reversed by the State supreme court when the case came before it on appeal; the court held that such motor vehicle lines were "transportation companies" and subject to the control of the commission because the constitution from which the commission received its authority gave the commission the power to regulate railroads and "other transportation companies." *Western Assoc.* v. *Railroad Commission*, 173 Calif. 802. In following the rules of construction the court must have concluded that motor vehicle common carriers resembled "railroads" closely enough so as to come within the category of "other transportation companies." In a great number of States which have had public utility acts and where power was given to commissions to regulate railroads, both steam and electric, the laws have been amended by adding motor vehicles engaged in common carrier service and by putting them in the same class as railroads. The Colorado Public Utilities act defines the term "common carrier" in saying: "The term 'common carrier' when used in this act includes every railroad, corporation * * * and every other corporation or person affording a means of transportation by automobile or other vehicle whatever, similar to that ordinarily afforded by railroads or street railways and in competition therewith."[2]

The statute of Maryland, which was one of the first States to regulate the motor vehicle as a common carrier, provided that the term "common carrier" includes all persons * * * operating automobiles and motor cars or motor vehicles for public use, in the conveyance of persons or property.[4] The completeness of the jurisdiction which the States have because of statutory enactments depends wholly upon the specific provisions of the law in each case. In most States the powers granted to the commissions are far reaching in character; in some States the jurisdiction applies to passenger motor vehicles alone; in New Jersey the commission has jurisdiction over and can regulate only those auto buses which operate over routes parallel to a street railway line or traction railway.[5] The Ohio law

[1]Arizona, California, Colorado, Connecticut, Georgia, Illinois, Iowa, Maine, Maryland, Michigan, Montana, Nevada, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Virginia, Washington, West Virginia, Wyoming.

[2]Chapter III, sec. 1, Laws of Washington, 1921.

[3]Chap. 127, sec. 2-E, Laws of Colorado, 1915.

[4]Chap. 180, sec. 1. 5, Laws of Maryland, enacted 1910, amended by Chap. 445, laws of 1914.

[5]Chap. 149, sec. 15, laws of New Jersey, 1921.

limits the commission to a supervision of the rates and service and safety of operation of common carrier motor vehicles; the control of competition with other transportation agencies is not delegated to the commission.[6]

Certificates of Public Convenience and Necessity

Wherever State commissions exercise complete control and supervision of common carrier motor vehicle transportation it is necessary that any one desiring to engage in this kind of service obtain from the commission a permit which certifies that the holder has the right to give service of a certain character between two definite terminals. This permit or certificate is not issued unless it is shown that public convenience and necessity require this new service or operation and consequently the certificates are generally called "certificates of public convenience and necessity." This procedure is taken directly from the railroad and public-utility laws and is the basis of the monopoly feature of such enactments. The New York Public Service Commission in one of its decisions has made a very good attempt at defining this term. "Taking the phrase as an entity," the commission says, "it does not mean to require a physical necessity or an indispensable thing. We take it that for such purposes as are involved in this and similar applications, a public convenience and necessity exists when the proposed facility will meet a reasonable want of the public and supply a need, if existing facilities, while in a sense sufficient, do not adequately supply their need."[7] In most states where laws have been passed requiring that no motor vehicles operate as common carriers until they have secured public convenience and necessity certificates it is provided that those operating at the time the law becomes effective are considered as being within their rights. The certificates may be good only for the year issued or they may be granted for an indefinite period; if granted for a year they are ordinarily renewed at the end of the year without any further formalities.

A good deal of the litigation before commissions and courts involving the regulation of the operations of motor vehicles as common carriers pertains to contests over the granting of a certificate of public convenience and necessity. Practically all of these cases grow out of applications to operate motor bus lines. The cases can be grouped into two classes; first, where an applicant seeks the right to operate in a field which is already occupied; second, where there are several applicants seeking the right to operate in an unoccupied area. The competition which would be set up in this first group of cases is with street railways in cities or in suburban sections, with steam railroads, and with other common carrier motor vehicles.

Street Railways Entitled to Protection Against Loss of Short-Haul Fares

The revenue feature is usually the one which receives the most consideration in determining whether or not a permit should be granted to operate a motor bus in direct competition with urban and interurban electric railroads. On account of the fact that a uniform flat rate of fare is being generally charged on street railway lines and that passengers are carried long distances as well as short distances for the same fare, the street railway finds its revenues seriously depleted if its short-haul passengers are taken away from it by a motor bus and the rate of fare for the other passengers may have to be increased, or at least it will make it impossible to reduce fares. For this reason public utility commissions in their decisions in such cases have taken the stand that street railways were entitled to protection up to a certain point. The loss in earnings of a street railway brought about through the competition of motor bus operation would result in preventing the street railway from securing the needed capital for extensions and betterments and the public would finally suffer. The check upon unwise competition in the opinion of the New York commission is abundantly justified from the point of view of public advantage. Petition of Gray (N. Y. 2d Dist.) P. U. R. 1916A. 33. That same commission holds that motor buses should be confined to streets and neighborhoods which are not served by street railroads except in cases where existing street railroads refuse to or can not supply the service requirements. Petition of Gray (N. Y. 2d Dist.) P. U. R. 1916A. 33.

In most cases it has been held that under the conditions existing in the larger cities motor-bus service can not be substituted wholly for street-car service because it would inadequately meet

[6]Act July 26, 1913.

[7]Re Troy Auto Car Co. (N. Y. 2d Dist.), P. U. R. 1917A, 709.

the public needs. At the time when the Oregon commission was considering an application for an increase in street railway fares in the city of Portland a suggestion was made that motor-bus transportation could be introduced and thus do away with street railway operations. After making a comprehensive study of the practicability and economy of motor-bus transportation the commission concluded that in these grounds it would not be justifiable to make a substitution. "Even on the more profitable lines of traffic," the commission said, "it appears that the cost would equal, if not exceed, that of the street railway, and because of the narrowness of Portland's streets the congestion of traffic which would be occasioned thereby would make it impracticable if not prohibitive." Re Portland Railway, Light Power Co. (Oreg.).

According to the New York commission there is justification in the competition between a line of motor buses and a street railway line "where it appears that there is such a divergence of routes and so much greater convenience afforded by the stage route that it may fairly be said that it supplies a want of the public not already adequately met." Re Troy Auto Car Co. (N. Y. 2d Dist. P. U. R.) 1917 A, 700. Just what distance there must be between the route of the motor-bus and street-car line so that there will not be an direct competition is a matter which must be determined in each individual case. It has been held that an auto-bus line operating over a route which was 2,500 feet from the nearest street railway did not improperly interfere with it and under those conditions a certificate was granted. Re Woodlawn Improv. Transportation Corp. (N. Y. 2d Dist. P. U. R. 1916D 1.

Competition of Motor and Railroad

When the operation of common carrier motor vehicles comes into competition with paralleling steam railroads practically the same policy is followed as in the case of competition with street railways. Where the service of the steam railroad is inadequate and unsatisfactory permits are granted. Re King. (Calif.) P. U. R. 1919F 377. Not many cases of this kind have arisen because the service of the motor-bus lines is in most instances purely local in character.

Commissions have uniformly held that where motor-bus lines are operating and giving satisfactory service they should be protected from competition of other operators. Re Automobile Stage Line (Ariz.) P. U. R. 1918B 292. If it appears, however, that there is enough business to warrant the establishment of a second line and the line already operating does not properly serve the public, certificates of public convenience and necessity are issued to applicants authorizing competitive service.

Where there is an unoccupied field and there are several applicants seeking permits to operate and it appears that the prospective business warrants only one line of motor buses, the commission has to take into account the relative ability of the applicants to furnish the required service. Re King (Calif.) P. U. R. 1917F 377; Re Chicago Motor Bus Co. (Ill.) P. U. R. 1918C 320. Such considerations as the financial responsibility of the applicants, the type of equipment, the proposed rates and schedules are all matters which are given due weight.

Through regulations and promulgation of rules the state commissions supervise the operations of motor buses; speed limits are established, provisions are made for all kinds of safety measures, rules of conduct and the hours on duty of drivers are definitely prescribed, the capacity loads are fixed, and all manner of precautions are taken for the benefit of the traveling public.

The Rate Question

In none of the formal proceedings have any definite principles been established as to the maximum rate of return which should be allowed to this new class of common carriers and public-utility enterprises. The business is new, and very little authentic information has been collected which would indicate what the return should be. The capital requirements are not so large as in other kinds of public utility undertakings. At the same time the business has been conducted in many instances by individuals who keep few accounts and who, at the best, have but a limited conception of the intricacies of cost accounting. Rate cases as such have not found their way to the dockets of public utility boards and commissions. Because of the lack of rate controversies, the valuation of the property of these carriers has not been necessary.

The regulatory laws of the various States provide that annual reports shall be filed in accordance with the requirements prescribed by the commissions. These reports at present contain fairly accurate data as to revenue; when it comes to a classification of operating ex-

penses there is an evident weakness. The item of depreciation usually receives very little attention; there is also noted a confusion in the minds of many of the small operators between wages and salaries on the one hand and return on the other. In those states where street railway companies have, either directly or indirectly, gone into the business of operating motor buses to supplement their rail service, reports and financial statements are filed which are properly made out by the accountants and clerks familiar with public utility cost accounting systems.

According to the information obtained from a number of state commissions which regulate the operations of all common carrier motor vehicles there is a tendency for the individual operators to be taken over by corporations organized for this purpose; consolidation of small operators is also noted. Large companies are appearing which control the routes in a given section of a state. The motor-bus business may pass through the same consolidation movement which took place in the early days of the street railway business.

ROUTING THROUGH MOTOR VEHICLE TRAFFIC

In the September issue of the American Motorist, official publication of the American Automobile Association, Alvan Macauley, President of the Packard Motor Company, indirectly approves the position of the Pennsylvania State Highway Department, which believes that through traffic should be routed direct to its destination.

In the selection of the routes of the nine named thoroughfares which carry the heaviest trans-state traffic, the Pennsylvania Highway Department adopted the shortest improved thoroughfares connecting important terminals. This plan has the unqualified approval of Mr. Macauley, whose article in the American Motorist is attracting wide attention.

"Mr. Macauley is right when he says that the modern tourist, knowing where he is going and traveling on a schedule which calls for a certain stop at noon and another at night, is not necessarily a potential customer in every community he traverses," says Paul D. Wright, Pennsylvania Secretary of Highways. "He is right when he says that dense through traffic has not been an asset to those merchants and business interests which have insisted on leading it by their doors."

According to the view taken by Mr. Macauley, a main route that leads straight through the business and shopping section of a city is as undesirable as a main line of a railroad that cuts through the heart of a community. Cities that are well planned allow the through traffic to pass by without business interruption, the article shows, yet allow for convenience of entrance into the business section if the road traveler desires to stop over.

"Left alone," says Mr. Macauley, "the majority of our state highway departments, with the aid and co-operation of the Federal Government, can, with a state and national viewpoint on the traffic situation, lay out a system of arterial highways which in addition to serving interurban traffic most efficiently will go far toward relieving many of the ills from which the majority of cities suffer.

"Our cities have just begun to wake up to the fact that it is not an advantage, but a decided disadvantage, to debouch into the malestrom of their downtown traffic, the through travel which has no desire whatever to be tangled up in city congestion, hampered and delayed by its necessary regulations and led by devious windings through main streets of business blocks where it does not wish to stop. Through traffic and intra-city traffic should be, insofar as possible, absolutely separated and it is odd that this apparently simple truth is only now beginning to be appreciated by the business and civic authorities of the average American community."

"Making cities way-stations instead of terminals" is the way Mr. Macauley sums up the subject. A recent census taken in downtown Pittsburgh on the Lincoln Highway, he contends, showed that some 20 per cent of the vehicles represented the through travel which did not want to be in that part of the city at all and which, had it been possible, would probably never have entered the city.

"The way-station ideal is alive in New York," the writer adds, "with talk of elevated marginal ways to make midtown New York a way-station for traffic from lower to upper Manhattan. On varying scales all cities need to study and work along these lines."

THE FIRST DUTY OF PUBLIC OFFICIALS

(Editor's Note: The following report of a recent British discussion is reproduced from our London contemporary, "The Surveyor and Municipal and County Engineer.")

The question, "What is the first duty of a public official?" was considered in an address which Sir Henry Bunbury, K.C.B., delivered to the members of the Sheffield and district group of the Institute of Public Administration held at Sheffield Town Hall recently.

Sir Henry said he was going to suggest a number of answers to his question, and then he would conclude with what he thought to be the true answer. The first answer was one that certainly would have been given during the cynical period of the eighteenth century: "To secure the emoluments of his office." Every post in the Government in those days was an office of profit under the Crown. The great attraction then was not the duty but the emolument of the office. In many cases the holder of an office was a person who had paid a big consideration for his post. Nobody would now suggest that that was the answer to his question.

The second answer was one which was very popular with the press in the South of England. He was not sure whether it was quite so popular with the hard-headed pressmen of the North. It was worded something like a passage in the church catechism. "The duty of the public official is to order himself lowly and reverently toward his betters," and by his betters, continued Sir Henry, they meant anybody who was not a public official. (Laughter.) The press expected them to be very humble, but that humility and reverence to anybody but themselves was not the first duty of a public official.

Another answer, which the general public might give was "To scorn delight and live laborious days." They expected officials not to take too much pleasure in life. They probably reached their conclusion from the conviction that public officials had soft jobs, and while they were amusing themselves in those soft jobs the public was paying. The public official, if he did his duty, had no soft job. Public work was becoming increasingly difficult. Since the war it demanded more imagination and study and continuous effort. The bureaucrat might suggest that the first duty of a public official was to "Learn, honor and obey the regulations of his department," but although there was a good deal to be said for that theory, it could be carried too far.

A rather different type of answer was that the official should serve loyally and to the best of his ability the authority of which he is for the time being the servant. That was a very important answer, and he would put it high on the list of merit. The answer he was going to submit, however, was "That the first duty of a public official is to seek and to declare the truth." The politician and the official were usually found together, but their functions were different. The function of the politician or statesman was to carry out what he judged to be the wishes of the electorate. He represented the community for the time being and was the servant of the community. The official, on the other hand, was the servant, the expert adviser and executive officer of the transitory politician. It was to him that those who had to take responsible action looked for advice.

The official could not do that unless he set before himself as his sole object the truth and nothing but the truth. That applied equally, whether he was an administrative, technical or scientific officer. Whether his advice was taken had nothing to do with him; that was for the elected ministers or councillors. The speaker thought that principle had an application to every official of every grade. In conclusion, he defined a public official as "a man who tells the truth."

ECONOMIC VALUE OF REINFORCEMENT IN CONCRETE PAVEMENTS

Announcement is made by Chas. M. Upham, director of the Advisory Board on Highway Research of the National Research Council, that Mr. C. A. Hogentogler of the U. S. Bureau of Public Roads, has been granted leave of absence in order to conduct for that Board a fact-finding survey of the economic value of reinforcement in concrete pavements. This survey is to be national in scope, and will be conducted in co-operation with agencies interested in this important subject. It is proposed to cover the various soils, traffic and climatic conditions throughout the United States.

Mr. Hogentogler has had 15 years of experience in highway construction and

highway research, which well qualifies him to take charge of the present investigation. After graduation from the Pennsylvania State College, and a short period with the Pennsylvania Steel Company, he was with the Pennsylvania State Highway Department, followed by several years on street and road construction with the Borough of Columbia, Pa. For two years he was assistant professor of Civil Engineering at the University of Idaho. He was then engaged in research with the U. S. Bureau of Standards, and finally with the U. S. Bureau of Public Roads, in which organization he has been for the past six years.

During this period, Mr. Hogentogler has been actively engaged in a number of important highway researches. These include the first impact and wear tests at Arlington Farms and the tests to determine the cushioning properties of tires now being conducted by the U. S. Bureau of Public Roads in co-operation with the Rubber Association of America and the Society of Automotive Engineers. In 1923 Mr. Hogentogler, as representative of the Bureau of Public Roads, conducted the study made in co-operation with the Advisory Board on Highway Research which resulted in the publication by the National Research Council of its bulletin No. 35, entitled "Apparatus Used in Highway Research Projects in the United States."

Mr. Hogentogler is the author of a number of important research papers which have appeared in "Public Roads" and were reprinted in various technical periodicals. He is a member of the American Concrete Institute and an Associate Member of the American Society of Civil Engineers.

THE INCREASED PRODUCTION OF ASPHALT FROM PETROLEUM

With the growth of the petroleum industry and the increased demand for asphalt, petroleum refiners have developed the production of asphalt from crude petroleum to an amazing extent. The first high grade commercial asphalt thus produced was obtained from California petroleum and was known as "petroleum asphalt" to distinguish it from the native lake asphalt.

After a comparatively short period of experimental refining, it was found that high grade asphalt, 99½ per cent pure bitumen, could be successfully obtained from various heavy petroleums, and that the consistency of such asphalts could be accurately and scientifically specified and controlled.

Statistics published by the United States Geological Survey show that while in 1902 only 21,000 tons of asphalt were produced from domestic petroleum, by 1922 the annual production from this source had increased to more than 354,000 tons. During 1913 the production from domestic petroleum was considerably supplemented by asphalt obtained from imported Mexican petroleum, which was found to be highly asphaltic in character.

By 1922 the production of asphalt in this country from the combined sources of petroleum supply totaled more than 1,242,163 tons, representing approximately a 1,700 per cent increase during a period of 20 years. The petroleum asphalt produced in 1922 amounted to about 90 per cent of the total asphalt produced and imported in the United States during that year, if the mineral matter present in the natural products is eliminated. During 1923 there was a further increase of about 20 per cent in petroleum asphalt production. Today more than 90 per cent of all the asphalt, excluding mineral matter, used in the United States is refined from petroleum.

As asphalt is recovered from petroleum by distilling off the lighter oils, which hold it in solution. It naturally follows that its production is incidentally attended by the simultaneous production of such distillates as gasoline, kerosene and lubricating oils. The automobile and motor truck owner is therefore vitally interested in the increased production and use of asphalt for a variety of reasons. The road over which he rides, certain material in the tires of his car, the oil with which his car is lubricated, the insulation on the electrical equipment, the waterproofing on the top and the fuel by means of which it is propelled are all derived from the same source—petroleum.

Asphalt is coming into very wide and varied uses. In addition to being used in paints, waterproofing materials, oil cloths insulations and roofing materials, as well as for paving country highways and private driveways the city streets and alleys, asphalt is being used more extensively for bridge and pier flooring, for paving playgrounds, tennis courts and aviation fields and for constructing sidewalks in the public parks and along the public streets.

WHAT HAPPENS WHEN DYNAMITE EXPLODES?

By Charles S. Hurter

Big dynamite blasts are more and more frequent items of news. Charges of dynamite are buried deep in the face of a cliff, an electric switch is turned, there is a deafening roar, and thousands of tons of rock come crashing down. What, the inquiring observer asks, produces this explosion? What actually happens when dynamite explodes?

To answer this question it is necessary to explain briefly what dynamite is. Reduced to its essentials, dynamite is a mixture of nitroglycerin with wood meal and nitrate of soda or nitrate of ammonia, or both. Nitroglycerin, in turn, is composed of several different elements,—namely, carbon, hydrogen, nitrogen, and oxygen, the molecules of which are grouped in such a way as to form a heavy, oily, yellow liquid. Now these same molecules are capable of arrangement in other groups to form several different substances instead of the one, and the bonds which hold them together in the particular arrangement which makes nitroglycerin are very weak.

Consequently, when the electric current sets off the detonator imbedded in the dynamite and this imparts a sharp shock and very high temperature to the nitroglycerin, the bonds between the molecules which compose the nitroglycerin break down. The nitrogen and some of the oxygen remain free—both of them, gases—while the other molecules instantly combine to form two compound gases, carbon dioxide and water vapor. The breaking down of the nitroglycerin and rearrangement of its molecules generates a great deal of heat—enough to raise the temperature of the gases to 6300 deg. F. or thereabouts—and this high temperature causes the other ingredients of the dynamite to decompose into gases, or to burn, with the release of still more heat. All of this takes place in a single instant and the highly heated and rapidly expanding gases, which would normally occupy a much greater volume than the dynamite, exert a sudden tremendous pressure on the walls of the bore hole. The rock gives way and the escaping gases set the air into violent vibration. To the beholder, the explosion consists of the roaring noise and the rending of the rock, but in reality these are only the audible and visible results of the rearrangement of the molecules of the dynamite when subjected to a shock from the detonator, this conversion of the nitroglycerin and other ingredients of the dynamite into gases constituting the actual explosion.

ROADSIDE PLANTING ON PENNSYLVANIA HIGHWAYS

Banks and slopes along Pennsylvania highways next year will glow with color. Flowering grasses, vines and shrubs will hide the yellow scars where fills or cuts have been made. The Department of Highways which some months ago announced the inauguration of a planting program, has revised that program to include the setting out of blossom-bearing vines and small trees.

Highway Department officials during the last few weeks have been in consultation with the Departments of Agriculture and Forests and Waters, the Game Commission, the Bureau of Municipalities and the State Botanist, relative to planting along Pennsylvania highways. Both Paul D. Wright, Secretary of Highways, and William H. Connell, Engineering Executive, are anxious to hasten planting so that passage over Pennsylvania roads will not be continuously through landscapes scarred by the activities of road builders.

The Highway Department in instructions to engineers has notified them that they may make requisition for vines and other growths they deem necessary. The state will require approximately 300,000 vines. These will include wild roses, rambler and creeper roses; the matrimony vine, which in spring has a yellow blossom; the kutzu vine, which bears a colorful berry; bush honeysuckle, the blossoms of which range from white to red; the yellow forsythea; shrub dogwood, which has white and pink blossoms; spirea, with its white blossoms; the snow berry, the Japanese barberry and the liberty iris, which has a lavender blossom.

But the colors will not be confined to the vines the Department will plant. The engineers are making selections from ten grasses—including white clover, the pink alsike clover, the blue hairy vetch, the purple alfalfa and yellow vaccaria. These grasses will be used for slope planting in conjunction with orchard grass, meadow fescue, tall meadow oat grass, Canada blue grass and perennial rye grass. In planting on the berms or shoulders of

the roads the Department will use Kentuky blue grass, red top, red fescue, alsike clover, perennial rye grass and white clover.

"At comparatively small cost Pennsylvania highways can be given a parkway resemblance," said William H. Connel recently. "There is no reason why the state's many marvelous miles of scenic splendors should be marred by unsightly cuts or fills and naked shoulders."

ILLINOIS HIGHWAY PROGRESS

Illinois is making very marked success in road construction even though weather conditions recently have been a source of delay. According to the construction report issued by the State Division of Highways, on Sept. 4, 1924, a total of 796 miles of pavement had been completed that far this year. This is approximately 115 miles more than had been completed at the same time last year.

During the week ending September 4, 47.58 miles of pavement were completed; 105 paving mixers, 9,900 men, and 2,475 teams were employed on the highways of the state in that week.

Frank T. Sheets, Chief State Highway Engineer, in discussing the road situation, stated: "The people of the state are justly proud of the great strides Illinois is making in road work. While all of us appreciate the great convenience afforded by hard roads, very few realize their meaning in dollars and cents.

"In recent years, there has been considerable research work conducted to learn the comparative cost of operating motor vehicles on various types of road. It has been established that, when a road carrying 500 vehicles per day is surfaced with a high type pavement, an annual saving of approximately $6,575 per mile will be effected. All of Illinois' trunk line highways carry an average of at least 500 vehicles a day; many of them carry several times that number.

"The present year will see about 1,200 miles added to the state's paved road system. This year's construction alone, then will afford a saving of approximately $8,000,000 each year for many years to come. If traffic on these roads should average 1,000 vehicles per day—a figure which may reasonably be expected—the saving in one year will amount to nearly $16,000,000. In other words, the roads constructed this year will add to the wealth of the state between $8,000,000 and $16,000,000 annually. In comparison with such savings, interest charges for bonds to finance this road construction sink into insignificance."

AUGUST MUNICIPAL LOANS LARGE

The output of new State and municipal loans in August, 1924, amounted to $108,079,615 and exceeded the July total by several millions. Compared with August, 1923, last month's loans were practically double, according to figures compiled by The Daily Bond Buyer of New York. August is usually the dull season in the municipal bond business. This year, however, the extreme ease of money attracted many borrowers who would normally postpone their loan operations until funds were actually needed.

With the abnormally large August sales included, the year's State and municipal borrowings have passed the billion dollar mark and are within just about $75,000,000 of the total sales during the entire year 1923.

The following comparison of State and municipal bond flotations in August and the eight months ended August 31st for ten years was compiled by The Daily Bond Buyer of New York:

	August	Eight mos. end. Aug. 31
1924	$108,079,615	$1,030,544,653
1923	62,328,420	745,974,926
1922	83,956,959	938,122,400
1921	105,193,625	722,211,386
1920	65,293,273	495,190,090
1919	60,166,231	444,704,033
1918	32,153,413	187,242,143
1917	28,382,385	332,480,650
1916	30,511,944	356,941,873
1915	22,279,309	366,596,258

PHILADELPHIA USES BANDIT-CHASING CARS

Bandit-chasing cars, manned by policemen with rifles, are now being used by the Department of Public Safety of the City of Philadelphia, in combating the activities of bandits. The cars are equipped with windshields and wind deflectors made of bullet-proof glass, which protect the officers from gun-fire. This special bullet-proof glass is made of three pieces of glass with two thin strips of pyralin sheeting cemented between

them. This sheeting retards the normal fracture of the glass under the impact of a bullet and there is no shower of flying pieces, but merely a cracking of the glass. Cars equipped in this manner give the police the advantage in a gunfire chase after bandits and have proven so practical in Philadelphia that a number of other cities are planning to install them in the near future.

Bullet-proof glass is also being used for windows in bank tellers' cages, theater and moving picture box offices, pay cars and bank collection cars, where employes who work behind ordinary glass shields were exposed not only to the hazard of the bandit's bullet crashing through, but also to the hazard of flying glass, should a pane be broken accidentally. To the casual observer this special glass has every appearance and possesses all the visibility of regular window glass.

PURCHASE OF MASSEY CONCRETE PRODUCTS PLANT

The purchase of the Milwaukee plant of the Massey Concrete Products Corporation and the concrete post business by the George Cutter Company of Indiana has just been announced by the Westinghouse Electric & Manufacturing Company. The Massey Corporation has been engaged in the concrete post industry, manufacturing the well-known line of Hollowspun reinforced concrete street-lighting standards and concrete poles for street railway service at the Milwaukee plant and the George Cutter Company will now undertake the manufacturing of these products.

For a number of years, the Westinghouse Company, through connections and relations with the George Cutter Company, has been engaged in the manufacture of cast iron poles for industrial, ornamental and street-lighting purposes at the George Cutter Works at South Bend, Ind. The addition of the Hollowspun line to the line formerly manufactured assures the Westinghouse Company a place among the foremost manufacturers of oriamental street-lighting equipment.

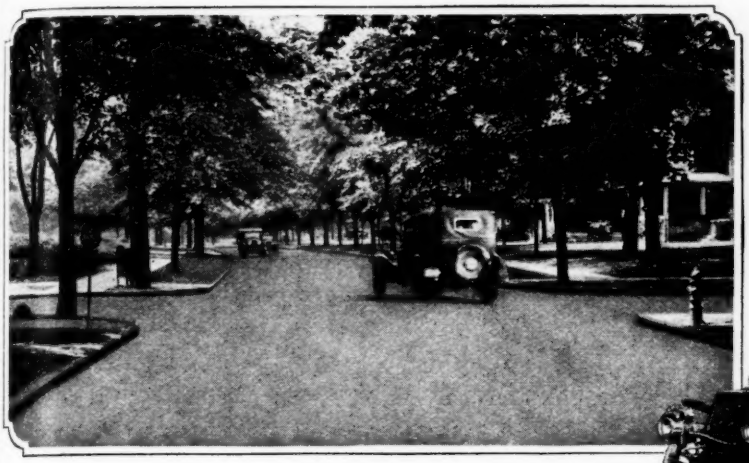
Hollowspun lighting standards which are made by the centrifugal process method demonstrate the possibilities of efficiently molding concrete. The tremendous force with which the concrete is tamped in the mold and around the reinforcement absolutely insures a uniform strength and surface texture throughout the length of the product.

The transfer of the Massey plant became effective July 1, and the Westinghouse Company will handle the Hollowspun business through the George Cutter Works.

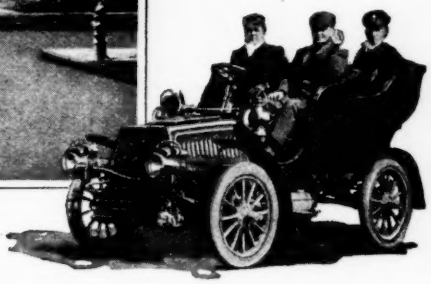
TRADE LITERATURE

Tarvia.—Three Tarvia booklets have just been issued by the Barrett Co., New York, N. Y. The first relates to Tarvia double seal pavements and shows step by step, in actual photographs, the construction of a Tarvia pavement. This book contains 24, 6x9-in. pages. The second book contains 52, 6x9-in. pages and relates to road maintenance with Tarvia The subject matter is subdivided according to the classes of road and pavement to be maintained, such as gravel roads, macadam roads, Tarvia resurfacing, Tarvia pavements, sheet asphalt, asphaltic concrete, bitulithic and other sheet pavements, concrete pavements, creosoted wood block pavements, brick pavements, cobblestone pavements and stone block pavements. A section is devoted to labor saving devices used in handling the work described. A brief, but interesting section shows how to widen narrow pavements with Tarvia shoulders. Patching with Tarvia is illustrated and described. This exceptionally interesting and valuable book concludes with a description of the use of Tarvia on bridge floors and railroad grade crossings. The third book contains 32, 6x9-in. pages and is a general discussion of the use of the six grades of Tarvia in road construction, repair and maintenance. This book contains several full page illustrations of typical Tarvia roads and pavements in various parts of the United States and Canada.

Public Utilities.—"Mighty Servants of Civilization," is the title of an interesting booklet of 40, 6x9-in. pages, issued by the National City Co., 55 Wall St., New York, N. Y. While this is intended primarily as an investors' prospectus it contains much sound information which would justify the interest of the engineer and the public official.



Bellflower Avenue, Cleveland, Ohio. Tarvia-built 1905.



Both were new in 1905— Today the Tarvia Street is Still Good

CLEVELAND, 1905! Bellflower Avenue paved with Tarvia! Traffic in those days was almost entirely "horse-and-carriage." Occasionally a motor car passed — a puffing, high-seated affair.

Time brings its changes. The old-time cars are junk. But the Tarvia pavement on Bellflower Avenue, after nearly 20 years of constant traffic, is as good as the day it was laid.

Nor is this exceptional. At remarkably small cost, Tarvia streets can be kept good for many years. And in addition: Tarvia pavements will not wave, roll or rut. Tarvia pavements are skid-proof because of their granular surface.

Thousands of Tarvia streets and roads have proved that—for the money spent—Tarvia gives more mileage and the most years of satisfactory pavement service.

On request, we will gladly send you descriptive booklet, construction data and specifications.

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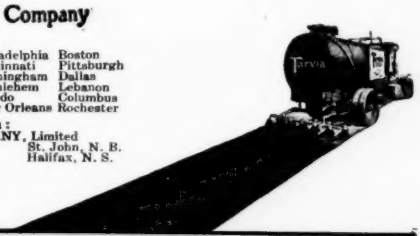
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